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ARTIFICIAL FERTILIZERS.

Of the various tried methods of producing artificial fertilizers by bringing about the fixation of the atmospheric nitrogen but two are still in operation, and as yet it can not be said that either of these is firmly established on a commercial basis. Theoretically, the processes are simple enough, as nitrogen and oxygen will combine when air is passed through an electric arc, but the practical difficulties of bringing about this reaction have been great. The chief expense of the process is the cost of the power, and the reaction, under ordinary conditions, is inefficient. Moreover, unless the oxides of nitrogen produced in the arc are immediately removed from it, they will be decomposed. In those processes which promise the best results this effect is overcome, to some degree at least, by drawing the treated air rapidly away from the arc. In the Birkeland and Eyde process, which seems to be the only one of this class still in operation, in addition to keeping the air flowing constantly through the furnace an alternating-current arc is employed, which, by means of a magnetic field, is blown rapidly across the stream of air, thus acting but a short time on any portion of it. The efficiency of this process is said to be higher than that of the other processes which have been tried, and the system is now in operation in Norway, where unusually cheap power is available. It seems likely that the last factor has contributed largely to the apparent success of this process.

The other process, which is being tried on a commercial scale in Italy, is also electrical, but the energy is used simply as a heating agent. The process depends on the reaction which takes place when calcium carbide is heated and brought into contact with nitrogen. One atom of carbon is given up, its place being taken by two atoms of nitrogen, resulting in the compound known as calcium cyanamide. As originally proposed, there are three stages in this process: The first is the production of calcium carbide, which may be carried on at the works itself, or the material may be purchased at a carbide factory; the second is the preparation of nitrogen; the third is the heating of the carbide and the passing of the nitrogen into it. Again, it will be noticed that the question of power is the most important item, as it is the controlling factor of each of these three stages. Improvements must, therefore, be directed toward reducing the cost of power and rendering the process more efficient. Energy should be saved wherever possible. One opportunity for so doing is the saving of the heat lost when the calcium carbide is allowed to cool, only to be reheated again to react with the nitrogen. This suggests that the two reactions might be carried on simul-

taneously, and has led to a modified process which is described by Mr. J. B. C. Kershaw in the *Electrician*, London, for January 24. The materials are prepared as usual for the production of calcium carbide. They are heated electrically and nitrogen is passed in at the same time, resulting in the formation of the cyanamide. A further improvement would be some method which would lower the temperature at which the reaction takes place. It has been found that certain materials, such as calcium chloride and calcium fluoride, have this effect. They are unchanged by the reaction and remain in the product as adulterants, and thus may be objectionable or not, according to their properties.

The nitrogen employed for this purpose may be prepared in any of the usual ways. That which seems to promise best, particularly when power is cheap, is the fractional distillation of liquid air. This not only separates the nitrogen, but produces oxygen as a by-product, for which there is a market.

The factory at present in operation in Italy has a yearly output of something less than 4,000 tons. It is said that one ton of nitrogen is obtained in the form of cyanamide with an expenditure of about two kilowatt-years by the old process; no figures for the modified process have been given. The material seems to have given satisfaction as a fertilizer, but it, of course, needs careful handling. In order to introduce it and create a demand for it, the producers have adopted a policy of selling it at a few dollars less per ton of nitrogen than ammonium sulphate brings. It is hoped that it will take the place of Chili saltpetre, the beds of which are being so rapidly exhausted. The material that is put out contains about twenty per cent of nitrogen and the calcium may itself be beneficial to the soil.

CENTRALIZATION OF POWER SUPPLY.

One of the marked tendencies of the electrical-power system during the past few years has been toward concentration: large companies have erected one large plant to take the place of a number of smaller plants; many companies operating in important cities have even extended this practice further, so that they are reaching far out into the suburbs and acquiring control of the small town and country systems and, in general, are shutting down their comparatively uneconomical plants and supplying the power from their large modern stations. There is, thus, a decided movement toward concentrating all the power-generating equipment for a large district in one or two enormous generating stations, and to feed all the outlying districts from these by means of moderate high-tension lines. As yet no very great distance has been covered in this way, compared with the long-distance transmission of power generated in water-power stations. In the case of the latter the point of generation, as well as the points of consumption, are fixed, and the market is really limited by the distance over which power can be transmitted economically. The fuel-burning station has not yet reached this stage. The station is located to the best advantage with respect to its market and the source of power. The fuel is brought to it, and the district supplied is not so large, because the cost of power produced by it is considerably greater than the corresponding cost for a large hydroelectric station. But if this cost should be reduced considerably by the use of improved methods or by avoiding losses and expenses now necessary, there does not seem to be any reason why a fuel-burning central station should not be placed at the source of fuel—the mine—and its lines extended as far as those of the hydroelectric plant. If, for example, the power station were put down at the mine, the cost of transportation of fuel would be saved, which in many of our larger cities amounts to a large part of the cost of the fuel. Moreover, the thermal efficiency of the modern steam plant is not at all high, although it is about as high as the system employed will allow. For instance, the power-house of the Interborough Rapid Transit Company, of New York city, is undoubtedly typical of the best modern practice. There are few other large generating stations which can compare with this, and none of the small ones, yet, according to the company's engineer, less than eleven per cent of the heat energy of the coal is converted into electrical energy. Surely there must be some more efficient way of converting heat into electricity than by passing it through steam.

There is a system which can show a much higher thermal efficiency than the steam plant, but this is a comparatively recent development. During the last few years it has made notable advances. This is the so-called producer-gas power system, about which so much has been heard but so little is known. In a recent bulletin published by the United States Geological Survey, Mr. R. H. Fernald discusses the latest information which the department has been able to secure relating to the manufacture and use of producer gas. This shows that a very considerable increase in thermal efficiency has been secured, and this system will convert several times as many of the heat units of a pound of coal into electricity as will the steam plant. In this study Mr. Fernald points out that the efficiency obtained at the Interborough power-house is unusual; that the usual thermal efficiency of steam stations is not more than five per cent. On the other hand, the information which he has secured, through reliable sources, shows that the producer-gas plant will convert about 21.5 per cent of the thermal energy into electrical. Indeed, some of the best-informed engineers consider that it can do better than this, and have given as a safe figure twenty-four per cent.

With such an increase in performance it would be expected that the producer-gas power plant would by this time have driven out, or would be driving out, the steam plant. That it has not done so is the result of a number of adverse conditions, some due to the system itself, and others simply to want of experience on the part of those who operate these plants. There is also a good deal of prejudice against the gas engine, much of it based on misinformation. It is said that the gas engine is not as reliable as the steam engine. Possibly not, for the latter is the result of several centuries of improvement. But the question to-day is: Is the gas engine reliable enough? Another of the great drawbacks has been the unsatisfactory performance of a few plants, due to the ignorance of the men in charge. While possibly no more skill may be necessary to obtain the highest efficiency in

the operation of a producer-gas power plant than to obtain similar results in a steam plant, it is true that the gas plant is generally installed in order to effect a saving in fuel. The operation of the plant is turned over to men who do not know how to get the best out of it. The result is that after a short time the owner is disappointed and he spreads a report that the system is unsatisfactory. This condition, while it may retard the introduction of the producer-gas plant, can not prevent it, and the showing of two or three well-conducted installations will go far toward laying the blame for the poor performance of others where it belongs. Moreover, a power company contemplating the installation of a large plant will not rely upon reports, but will make a thorough investigation before reaching any decision. Until recently large installations were almost impossible, because gas engines of small size only were available, but now nearly any size of engine may be obtained. In fact, some units rated as high as 6,000 kilowatts are in operation. It will not be surprising, therefore, if the next few years should witness a very notable increase in the installation of producer-gas plants. Indeed, Mr. Fernald thinks that this has already set in, and that before long the steam plant will be driven from the field. This hardly seems probable for some time to come, as the steam engine, of either the reciprocating or turbine type, has some advantages of its own, which, for certain purposes, may overbalance its defects as a transformer of energy. Another drawback to the increasing use of the producer-gas plant was the inability to burn poor fuel in it. This, however, can be done, as was demonstrated during the test of fuels conducted by the government at St. Louis.

To-day there is no reason why a large producer-gas plant should not be erected at the mine, and power distributed from there to large districts. It is only a question of whether the times are ripe for this development, as there are few mining districts which offer good markets for large amounts of energy. But when taken in connection with the proposed conversion of the steam roads to electricity there should be no difficulty in disposing of large amounts of power. This phase of the problem is touched upon by Mr. Fernald, who says that if the records of the hydroelectric plants can be taken as any indication, it would be economical to distribute power from a producer-gas generating plant throughout a circle of 250 miles in radius—that is to say, such plants need not be closer together than 500 miles. Under these conditions ten or twelve large central generating plants located at the various mining centres would be able to operate all the great railroads in the United States, if they were electrified. Trains could then be run from the Atlantic to the Pacific without calling upon a single steam locomotive, and all the advantages and comforts of electric traction would be secured. This is a development which every electrical engineer should be delighted to witness. So far as his work is concerned, he is practically ready, as he is now transmitting power 200 miles or more, and he is operating the heaviest railroad trains by means of electric locomotives. He must, therefore, turn to the mechanical engineer and co-operate with the latter in developing the producer-gas generating station.

There is one aspect of this problem of very large economic interest. The steam locomotive is notoriously wasteful of fuel, because it must work under such disadvantageous conditions. If it were replaced by the electrical system, drawing power from producer-gas generating plants, a very considerable saving of fuel should result, and the day when these supplies will be totally exhausted will be moved further into the future.

THE ELECTRICAL SUPPLY OF PARIS.

Some time ago plans were proposed for supplying the city of Paris, France, with electric power. At the present time this supply is maintained by a number of small companies, which, due to official regulations and other retarding influences, have left that city rather backward in this respect. The city has, however, taken the matter in hand, and is planning for a complete modern system of supply. These plans consider the establishment of a number of modern generating stations at or near the city.

While this matter was under discussion it was proposed to utilize the hydraulic power of the River Rhône for supplying Paris. The distance of transmission would be nearly 300 miles, but at the point where the station would be established there would be available about 80,000 horse-power during the dry season, and this could be about doubled for three hundred days during the year. By establishing a large storage basin the 80,000 available horse-power could be very considerably increased. The point where it is proposed to erect the plant is near the Genissiat bridge. Here a dam could be erected at the lower end of the Rhône gorge, while above the dam, Lake Bourget could be utilized for equalizing the flow. The plans proposed contemplated a Thury direct-current system of 120,000 volts.

More recent suggestions are interesting, since in these the three-phase high-tension transmission system used in this country is substituted for the direct-current system, as it is said that certain changes in the law relating to the transmission of electrical energy make the alternating system more advantageous than the other. It would be interesting to know just what these changes are, as heretofore the great advantages urged for the direct-current system have been its simplicity and efficiency. The plans now contemplate delivering about 70,000 kilowatts at Paris, two routes being followed by the transmission lines so as to insure an uninterrupted supply. Power will be generated at 10,000 or 20,000 volts and transformed up to 120,000 volts for transmission. It will be transformed down at substations to 10,000 or 15,000 for distribution to secondary distributing points. These plans, it is thought, will bring to Paris an ample supply of cheap power, which will have a very great benefit upon the industries of that city. The effect there will be watched with very great interest throughout the world, as other large cities are struggling with similar problems, and some of them are not so fortunately situated with respect to hydraulic power.

LONG-DISTANCE ELECTRIC-POWER TRANSMISSION BY DIRECT CURRENT.[1]

BY L. A. HERDT.

This is a descriptive paper on a subject that is stirring the attention of the engineers in Europe, namely, long-distance electric-power transmission by direct current.

This article does not accept the view that three-phase transmission for alternating current is now conceded to be the only practical and economical means of transmitting large quantities of electrical energy over great distances. This is not the opinion of European engineers. On the other hand the application of alternating current to long-distance transmission has engaged and is still engaging the undivided attention of Canadian and American engineers, who seem to be riveted to alternating-current work.

The advantages of the revolving-field alternator and of the static transformer are so great that they have monopolized the field of power transmission.

As the distances of transmission and the amount of power to be transmitted are increasing, the voltage has been raised, until to-day 50,000 and 60,000-volt plants are operating with complete success. Higher voltages are being considered for extremely long transmissions involving large amounts of power. Transmitting 40,000 to 50,000 kilowatts over a distance of one hundred miles at 60,000 volts requires a transmission-line expenditure figuring to almost half the cost of the entire plant. If, on the other hand, higher voltages are used troublesome and difficult complications will be met.

In Europe high-tension direct-current series systems are in use for some of the longest-distance transmissions and some schemes, in which the distances of transmission are 150 miles and over, are considered feasible only by means of direct-current transmission.

The writer, in a visit to Europe last year, had the privilege of visiting some of these direct-current plants, and was impressed by the strong claims made for this system, particularly as regards the transmission line.

The high-tension direct-current series system, or the Thury system, is an enlargement of the old Brush series system, with motor-generators substituted for the arc lamps.

The generators at the generating station are connected in series. At the receiving end of the line series-wound motors are connected in series. The current in the system is kept constant at all times, variation of load being met by a change in the electromotive force of the system. When the plant is not running all the machines, generators and motors are short-circuited. To switch in a generator the machine is run up to speed until it generates the proper line current, the short-circuiting switch is then opened, the generators being then in series with the line.

The motors are started in the same way. The short-circuiting switch having been opened, the brushes, which were placed, when standing still, in line with the axis of the poles, so that one-half of the armature conductors are acting against the other half position, corresponding to no torque on the armature, are slowly rocked forward in the direction of rotation, causing the motor to start and speed up. When at full speed an automatic regulator, working on the brush position, maintains the speed constant, through a regulation of the counter electromotive force of the motor. The motors are placed in substations and drive at constant speed, generators supplying current for local distribution.

As the load increases generators and motors are started, being thrown in series in the line.

To shut down a motor the brushes are rocked to the non-working position; the machine when stopped is short-circuited.

At the generating station the current is kept constant, as the load varies by either working on the speed of the prime movers or by regulating the position of the brushes. In almost all the plants the regulation for constant current is effected through speed control of the turbines, the position of the brushes remaining fixed. To distribute the load evenly among the generators in the same plant, an electromagnetic governor is provided which controls the speed of all the turbines.

In the Moutiers-Lyon plant 6,300 horsepower is transmitted a distance of 112 miles at a potential of 57,600 volts direct current.

Each generator unit is made up of four direct-current, 270-kilowatt, 3,600-volt machines, giving a total of 1,080 kilowatts per unit at 14,400 volts. These four machines are connected to a water turbine operating under a head of water of 215 feet. Four sets are in operation for full-load voltage. The regulation of the line current, brought about by controlling the speed of the prime movers, is obtained by a regulating gear. As the current in the system is constant it necessarily requires constant torque prime movers. With water-wheels great difficulties had to be overcome to make such machines constant torque machines. Mr. Thury, for this purpose, inserts between the wheels and the generators an elastic and slipping coupling. The slipping of this coupling protects the prime movers from sudden strains due to sudden variations of load. All the generators are insulated from the earth, for, if this was not done, one of the generators would have to bear the full difference of potential between line and earth. In the Moutiers-Lyon plant all the machines, electric regulators, switchboards, etc., are carried on insulators and placed on foundations of asphalt concrete, a layer of pure asphalt forming the flooring.

The transmission line is made up of two No. 000 Brown & Sharpe copper conductors, carried on triple petticoat insulators placed on wooden poles. The resistance of the line is ninety-eight ohms, the current carried, seventy-five amperes. As this current is constant the loss is 551.25 kilowatts, that is, there is thirteen per cent energy loss when the plant is operating at full-load potential. This means a heavy percentage loss when the plant is carrying only a portion of full load, as this loss is constant whatever be the output of the plant.

There are two receiving stations, one of which is equipped with three sets of two series motors in series connection, of 360 horse-power each; that is, 720 horse-power to the set. These motors are on the same shaft, and are direct connected to 500-kilowatt, three-phase alternators supplying light and power. The second substation, 2.5 miles distant, is equipped with five twin motors of the same size as stated above. These drive 500-kilowatt generators direct current for the street railway system of Lyon.

The advantage claimed for this direct-current system is the possible use of much higher voltages than those considered possible with the alternating-current system, and that it does away with the inductance and capacity effect of long transmission lines. An insulator that will withstand 60,000 volts, working voltage, across the wires of a three-phase alternating-current line should be able to carry 84,000 volts direct current, as the breaking-down voltage for air is determined by the maximum value of the dielectric stress. It has also been pretty well established experimentally that the difference is greater than the above one, recent results pointing to a ratio of nearly two to one.

If the middle point of the direct-current

[1] A paper read before the Canadian Society of Civil Engineers, November 7.

generators connected in series be grounded, a 60,000-volt insulator can be worked at 84,000 volts or more above ground, or 168,000 volts between wires. This even excludes questions of surging and resonance which compel a larger factor of safety in the alternating-current lines. There is no inductance effect in the direct-current system, and the conductors can therefore be separated any distance. Such a condition naturally affects the regulation of an alternating-current line and requires the wire to be placed as close as possible.

D. Kos, in an article appearing in the issue of the *Electrical World* for October 26, 1907, works out the relative costs of direct-current and alternating-current lines, assuming the same maximum voltage between line and earth. He shows that with a power-factor of eighty per cent the three-phase system requires about three times the weight of copper required for the direct-current system.

The total cost of a power-transmission system is made up of:

(1) The cost of the generating station.
(2) The cost of the substations.
(3) The cost of the transmission lines.

The cost of the direct-current generating station is greater than the alternating current one. This is due to the smaller units, and consequently their greater number for a certain output. In the Moutiers-Lyon plant a 1,000-kilowatt unit is made up of four machines. Larger direct-current units can be built, but their size is limited by the voltage that can be safely carried on a commutator.

The direct-current substations are costly on account of the small size of the motor-generator sets.

The direct-current line is very much cheaper than the alternating-current one. It follows therefore that, if the line bears a very high proportion of the cost of the whole plant, the advantage of lower cost may be with the direct-current plant.

The relative cost per kilowatt for a power development of 45,000 kilowatts, with a distance of transmission close to 100 miles, shows the following figures:

Direct current, 96,000 volts:

	Per Kilowatt.
Generating plant (electrical equipment).....	$22.50
Transmission lines (cable and poles, 10% loss)...	12.80
Substations (motor generator sets and switching)	24.00
Total.....	$59.30

Alternating current, three-phase, 66,000 volts:

	Per Kilowatt.
Generating plant (electrical equipment).....	$18.20
Transmission lines (cables and towers, 10% loss)	28.50
Substations (transformers and switches).....	12.75
Total.....	$59.45

The figures for the direct-current proposition are a little less than for the alternating-current one.

When it becomes necessary to increase the voltage to double the above alternating-current pressure, the direct-current system will, without doubt, have to be very seriously considered.

A New Alternating-Current Motor.

A patent has recently been issued to Carl Alfred Lohr, of Schenectady, N. Y., for the invention of an alternating-current motor of the class particularly of rotary-field motors in which alternating currents of different phases are used for generating the magnetic rotary field. The

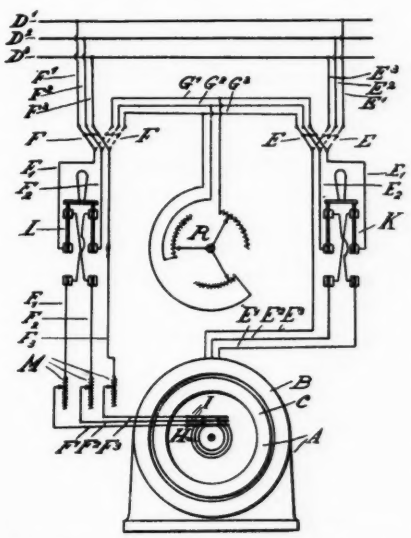


FIG. 1.—LOHR ALTERNATING-CURRENT MOTOR.

object of the invention is to provide a simple means for changing the speed of the motor and to do away with the changing of the number of poles or the use of different stators or rotors. The invention broadly consists of an alternating-current motor so arranged that its speed may be readily changed, and this will be easily

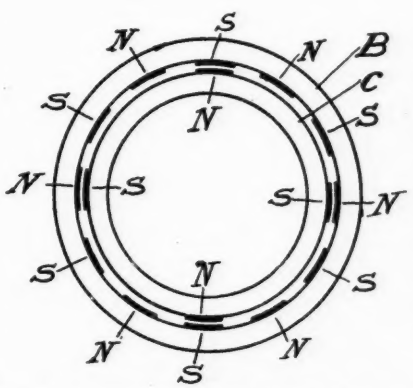


FIG. 2.—LOHR ALTERNATING-CURRENT MOTOR.

understood from a reference to the accompanying illustrations.

Fig. 1 shows a diagram which indicates the electrical connections used for changing the speed of the motor. The alternating-current motor is represented by A, and B shows the stator and C the rotor. D^1, D^2 and D^3 are main conductors connected with a three-phase, alternating-current source, and E^1, E^2 and E^3, when in contact with a double-throw, triple-pole switch, E, energize the stator. Three other supply conductors, F^1, F^2 and F^3, when in contact with the double-throw, triple-pole switch, F, serving to energize the rotor. Auxiliary conductors, G^1, G^2 and G^3, have interposed therein a regulating resistance, R, and are properly connected with the conductors, G^1, G^2 and G^3, and thus connected with the switch, E, when thrown as shown in the full-drawn position, or connected with the switch, F, when thrown as shown in the dotted position of the switch.

The arrangement of this alternating-current motor differs from the usual construction in that both parts of the motor generate rotary fields when supplied from the alternating-current source. The speed of these rotary fields may be either the same or different. The speed may be different by the use of a different number of poles in the stator and rotor, or by connecting the stator and rotor each with a source of electricity, each having a different periodicity. Also, the direction of rotation of the rotary fields in the stator and rotor may be the same or different. Two other cases also are possible: Either to generate a rotary field in the stator and connect the rotor with the variable resistance, R; or connect the stator with the variable resistance, R, and connect the rotor with the current supply.

When only the stator is connected with the line, and the switch, F, is thrown so as to make connections with the conductors, G^1, G^2 and G^3, and thus connected with the variable resistance, R, the motor will run asynchronously with the speed of the stator field. When, however, only the rotor is connected with the line—that is, the switch, F, making connection with the conductors, F^1, F^2 and F^3, and the switch, E, thrown so as to make connection with the conductors, G^1, G^2 and G^3, and thus connected with the variable resistance, R, then the motor will run asynchronously with the speed of the rotor field.

When both members, stator and rotor, are simultaneously connected with the line—that is, the switch, E, making connection with the conductors, E^1, E^2 and E^3, and the switch, F, making connection with the conductors, F^1, F^2 and F^3, and when the rotary fields are generated in opposite directions, having properly thrown the reversing switches, K and L, then the motor will run synchronously with a speed equal to the sum of the rotary field speed. When

the rotary fields in stator and rotor are generated so as to rotate in the same direction, having properly thrown the reversing switches, K and L, then the motor will run synchronously with a speed equal to the difference of the rotary field speeds.

The general application of this invention, therefore, may be summarized as resulting in the following different types of alternating-current motor: An alternating-current motor producing two speeds, one asynchronous, the other synchronous, by connecting alternately either one member alone or both members simultaneously with the alternating-current line. An alternating-current motor producing substantially a synchronous speed by connecting both members simultaneously with the alternating-current line. These two types of alternating-current motors are obtainable by employing the principles as described, and a motor having the same number of poles in the two motor members. By employing the principles as described and a motor having a different number of poles in the two motor members, the following types of alternating-current motors can be obtained: An alternating-current motor producing two asynchronous speeds obtainable under load by alternately connecting only one member with the alternating-current line and closing the other member upon itself. An alternating-current motor producing two asynchronous and two synchronous speeds by alternately connecting only one member with the alternating-current line and closing the other member upon itself, and by simultaneously connecting both members with an alternating-current line and changing the direction of rotation in the rotary field in one member. An alternating-current motor producing substantially a low synchronous speed equal to the difference of the rotary field speeds in stator and rotor.

Technical Publicity Association.

A meeting of the Technical Publicity Association was held in New York city on the evening of January 30, when R. F. Bieber, president of the 1900 Washer Company, and W. H. Ingersoll, advertising manager of the National Cigar Stands Company, made addresses on the topic, "Mail-Order Advertising." After the addresses the subject was discussed generally.

An Ungrounded, Closed Circuit for Receiving Wireless Signals.

TO THE EDITOR OF THE ELECTRICAL REVIEW:

Dr. Lee de Forest and O. C. Roos, in communications to the *Electrician* (London), have taken exception to some of the statements in an article entitled "An Ungrounded, Closed Circuit for Receiving Wireless Signals," published by the writer in the ELECTRICAL REVIEW of June 15, 1907.

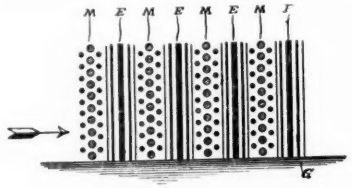


FIG. 1.—VERTICAL SECTION OF PORTION OF WAVE-TRAIN.

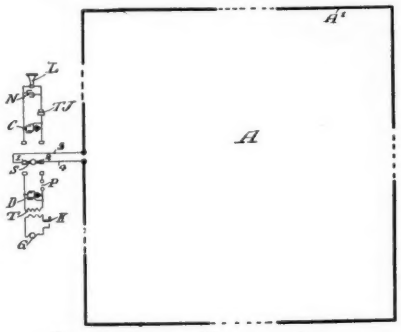


FIG. 2.—SIMPLE MAGNETIC LOOP.

Dr. de Forest claims[1] that he has previously described, in his United States Patent No. 771,819, of 1904, such a circuit adapted as a telegraph or telephone system employing the magnetic components of electromagnetic waves. That this view, however, is not held by the Patent Office is shown by the broad patent recently granted to the writer for such a system—United States Patent No. 276,996, dated January 21, 1908. Probably no further comment on Dr. de Forest's communication is necessary.

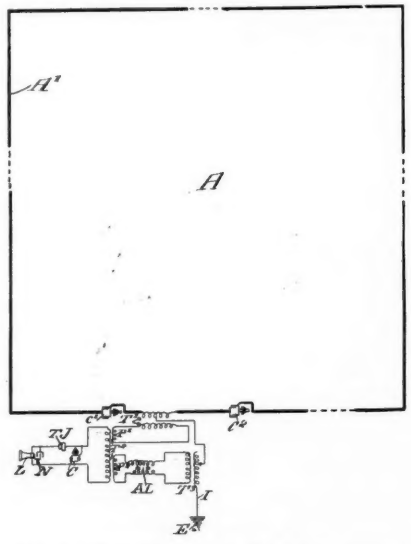


FIG. 3.—MAGNETIC LOOP COMBINED WITH CONVENTIONAL ANTENNÆ.

Mr. Roos[1] disagrees with the writer's statement, that in an electromagnetic wave the magnetic component is ninety degrees, or a quarter wave-length, behind the electric component, and considers that they coincide in phase, quoting Stokes and Maxwell in support of his belief. The writer wishes to point out, however, that all authorities are not with Mr. Roos. For example, Fleming[2] states: "At a distance from the oscillator we have a spherical wave of electric radiation, the electric force everywhere being tangential to the surface, directed, so to speak, along lines of latitude and magnetic flux directed along lines of longitude if we suppose the z axis to be the axis of rotation of the earth. The magnetic flux and electric strain are periodic, or fluctuate harmonically in space and in time, but the magnetic flux is a maximum when the electric force is zero, and *vice versa*."

Furthermore, a simple demonstration, to be hereinafter described, seems to show the correctness of the writer's statement regarding phase difference between the components of the wave.

Of the accompanying figures, Nos. 1-3 are those of the patent drawings, and Fig. 4 shows two diagrams of curves illustrating the combination of the wave-components at the receiving installation, as determined by said demonstration.

Said patent recites substantially as follows:

Fig. 1 represents a section of a train of electromagnetic waves, E, E representing the Faraday tubes or electric components, and M, M the magnetic components, lagging ninety degrees or a quarter wave-length behind the electric components; G being the earth. In Fig. 2, A represents an area of a large order, enclosed by a conductor A′ of minimum inductance, to any point of which are connected suitable transmitting and receiving apparatus, as shown, including the perfect-contact thermo-junction or rectifying oscillation detector TJ of the writer's patent No. 877,451 of January 21, 1908, with which detector no auxiliary source of electromotive force is em-

[1] *Electrician* (London), August 30, 1907.

[1] *Electrician* (London), September 20, 1907.

[2] "The Principles of Electric Wave Telegraphy," p. 333, 1906.

ployed. Syntonization is effected solely by the variable condensers C and D. In Fig. 3 both the electric and magnetic wave-components are employed, the former by means of the earth connection I and transformer T^3, and the latter as in Fig. 2, but by added transformer T′ and primary P′ of transformer T^2. Transformer T′ is substantially non-inductive with respect to the energy of the electric components, and the currents of such energy are retarded by artificial line AL (in the particular case shown in this patent), so as to bring the two sets of currents in phase to be added together in transformer T^2. With respect to the magnetic component, the distance between the magnetic loop (Fig. 2) and earth is immaterial, because the operation of the detector is entirely by the currents set up in the loop circuit by the magnetic lines which thread it. The addition of a metallic earth connection to any point of the loop otherwise entirely insulated from earth, fails to produce the slightest observable effect upon the intensity or tune of the received signals. The loop circuit is arranged for optimum effect, with its enclosed area normal to the planes of the circular lines of the magnetic components, and parallel with the direction of wave-propagation, in order to permit the threading through the loop of the greatest possible number of magnetic lines. The loop-circuit is independent of height, and it is entirely immaterial as to what part of the circuit the local apparatus is connected. No high poles or masts are needed, and the action is apparently not materially affected by surrounding vegetation or other conductors. The oscillations are very persistent and the tuning very sharp, owing to the lack of requirement of material inductance. Of course, no insulation is required between any part of the loop circuit and earth. Interference by foreign disturbances such as "static" are reduced to a minimum, owing to the fact that the loop circuit as a whole is normally charged to the potential of the surrounding air, and discharges of this kind may be prevented. Obviously the magnetic loop provides a means of directive transmission.

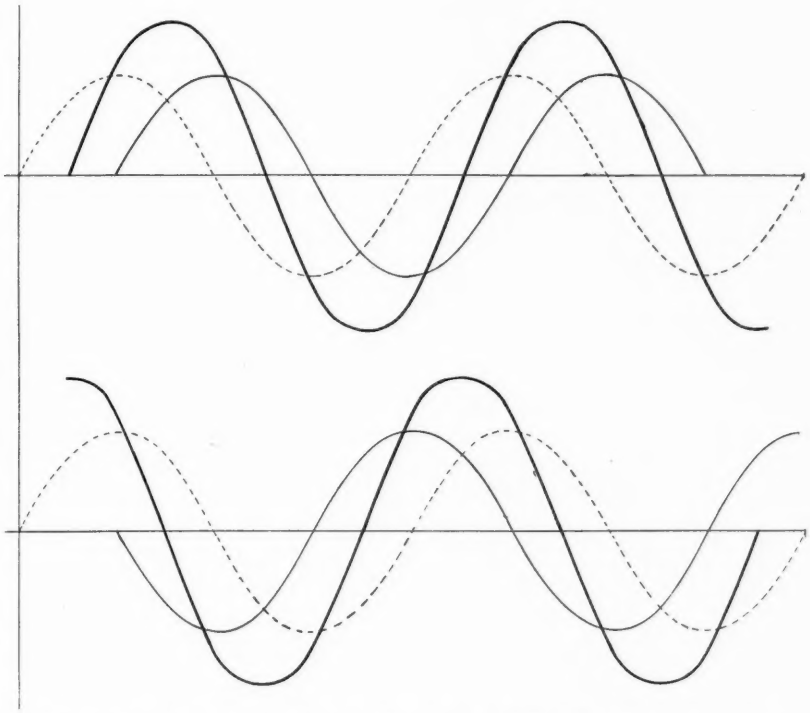


FIG. 4.—CURVES OF RESULTANTS OF MAGNETIC AND ELECTRIC WAVE-COMPONENTS.

The patent contains the following claim, among others:

"Means for employing the magnetic components of electromagnetic waves for the intercommunication of telegraphic or telephonic signals and messages, which comprises a closed electrical circuit enclosing an extremely large area, said circuit being adapted to be increasingly effective in receiving the energy of the magnetic component as its enclosed area approximates a position normal to the plane of the circular magnetic lines so as to thereby include a correspondingly larger number of the magnetic lines within the closed circuit."

The statement objected to by Mr. Roos is that referring to the lag of the magnetic components behind the electric components. The simple demonstration referred to above is as follows:

Using the receiving circuit shown in Fig. 3, but eliminating the artificial line AL and the variable condenser C, and arranging the primaries P^1, P^2 of the oscillation transformer T^2 in such wise that either could be withdrawn from inductive relation with the secondary, and so proportioning the closed circuit A^1 that equal amounts of energy were received from each of the electric and magnetic components respectively, as indicated by the response in the telephone receiver L (such response being the same when either primary winding P^1 or P^2 alone was acting upon the secondary), a marked increase of sound was obtained when both primaries were allowed to act together upon the secondary. By means of a switch, not shown in Fig. 3, the primary P^2 was then reversed with respect to the primary P^1. This reversal produced no change whatsoever in the intensity of the response, when both primaries acted together upon the secondary.

Fig. 4 will serve to make clear the meaning of the above operation.

In the upper curve of this figure is shown the addition of two equal sine waves, differing by ninety degrees in phase, the electric component being indicated by a fine full line, the magnetic component by a dotted line and the resultant current by a heavy full line.

In the lower curve is shown the effect of reversal of primary P^2. As the current in P^2 is that due to the electric component, the fine full line is reversed or shifted in phase by 180 degrees. The magnitude of the resultant current is in no way affected by this reversal, save that it is advanced in phase by ninety degrees. Obviously, the currents in P^1 and P^2, due to the magnetic and electric components of the wave, respectively, must differ in phase by ninety degrees (or any odd multiple of ninety degrees) to produce this result. With any other phase relation, reversal of one component with respect to the other must cause a variation in the intensity of the added currents.

The receiving circuit employed in this demonstration had for its greatest dimension a length of thirty metres, while the wave-length of the distant station[1] was 1,800 metres. It is evident from this that the receiving circuit was small as compared with a quarter wave-length, and that no question of difference in phase between different parts of the same circuit could be considered. Also, as the sending station was some seventy-five wave-lengths distant, it could hardly be said that the demonstration was made in too close proximity to the source.

GREENLEAF W. PICKARD.

Amesbury, Mass., February 10.

[1] The Marconi Station at South Wellfleet, Mass.

Receiver for the Whitney Company.

The Whitney Company, a $10,000,000 concern operating about thirty miles below Salisbury, N. C., has been placed in the hands of a receiver by order of Judge J. R. Pritchard, of the United States Circuit Court. Col. John S. Henderson, of Salisbury, a former member of Congress from North Carolina, has been named as receiver. The application was made by A. O. Brown & Company, of New York. The company has been building one of the largest power plants in the South, and has nearly completed the work. It was expected that the plant would be ready to distribute power by July.

The receivership was brought about by inability to meet interest and principal on notes and bonds, and because of threatened suits from creditors.

The Whitney Company is chartered under the laws of North Carolina. It has a capital stock of $10,000,000 and bonds outstanding to the amount of $5,000,000. The company has spent $5,000,000 in the construction of a dam across the Yadkin River, and proposes to furnish current for light and power to cities and towns within a radius of 100 miles from the plant.

E. F. Buchanan, president of the Whitney Company, has stated that a plan for the readjustment of the finances of the company would be completed very shortly. The receivership proceedings are in the nature of a friendly suit. The company has to develop three additional dam sites and needs about $1,500,000 for this purpose. It has no way of issuing any more first-lien securities, and the action has been taken in order to bring about a readjustment that would permit this. It is expected that the work will proceed without hindrance, and efforts made to complete the plant at the earliest possible moment.

Annual Dinner of the American Institute of Electrical Engineers.

The annual dinner of the American Institute of Electrical Engineers will be held in the grand ballroom of the Waldorf-Astoria, Fifth avenue and Thirty-fourth street, New York city, on Wednesday evening, February 19, at 7 o'clock. This dinner will feature the relation of the electrical engineer to public service, and among the guests of honor will be men prominently identified with public service, either as members of public-service commissions or as officials of public-service corporations.

As on former occasions, ladies will be present, and arrangements have been made to make the function particularly enjoyable to them.

The following is a list of speakers and the toast to which each will respond: Walter C. Kerr, "The Ethics of Public Service"; Theodore P. Shonts, "The Electric Railways and the Public"; Frank W. Stevens, "State Control of the Public Service Corporations Past and Present"; Charles R. Huntley, "The Electric Lighting Companies and the Public"; B. A. Behrend, "Altruism *versus* Egoism in Public Service"; T. C. Martin, "The Technical Press and the Public"; Charles P. Steinmetz, "The Engineer and the Public."

Governor Hughes has written that if it is possible he will be present at the dinner.

The toastmaster will be Henry G. Stott, president of the American Institute of Electrical Engineers.

New Haven Reduces Force.

It is understood that as the result of a meeting of the division superintendents of the New York, New Haven & Hartford Railroad, the management of the divisions, under the proposed readjustment to become effective February 16, was settled. Divisions were assigned as follows:

New York (electrical zone), superintendent, J. P. Hopson, with offices at New York.

Shore Line, superintendent, C. N. Woodward, with offices at New Haven.

Western, superintendent, C. S. Lake, with offices at New Haven.

Midland, superintendent, B. R. Pollock, with offices at Hartford.

Providence, superintendent, J. A. Droege, with offices at Providence.

Old Colony, superintendent, Andrew Ross, with offices at Taunton.

A. W. Martin, who has been assistant general superintendent with offices at Boston, will be, it is understood, made superintendent of terminal in that city, and the office of assistant general superintendent is abolished. There was little discussion in regard to the disposition of the minor officials and nothing indicated as to the fate of the assistant superintendents nor as to the trainmasters. There will be one master mechanic with each superintendent.

It is seen that by the reorganization of the divisions of the system four division superintendents are dropped and that there has been a general shift in the positions of those remaining. A. W. Honywell, the present superintendent of the Hartford division, with offices in that city; William Daniels, at New Haven, superintendent of the Air Line-Northampton division; George T. Taylor, at Boston, superintendent of the Plymouth division, and I. N. Marshall, at Taunton, superintendent of the Taunton division, are the four division heads who step down when the readjustment of the divisions takes effect next week.

The Swedish State Telephone.

The development of the state telephone has been continuous and on an unexpectedly large scale; there is every reason to expect a similar growth in the future, and the department in question is exerting itself to keep up with the increasing requirements. In no country has the general public of all classes taken more kindly to the telephone than in Sweden, and one finds it in the most distant parts and most unexpected places. A few figures will show the importance to which the Swedish state telephone has attained. At the end of 1906 the state telegraphs had an aggregate length of about 19,030 miles. The increase during last year of the state telephone system amounted to 10,540 miles, which brought up the total state telephone mileage at the end of the year to 114,540 miles, or six times that of the state telegraphs. During the last ten years the aggregate length has been more than doubled (47,000 miles in 1897). The number of central and exchange stations has during the same time grown from 734 to 1,497, and the number of telephone apparatus from 32,892 to 90,811 Of the above aggregate mileage of telephones, only 2,250 miles are single wire. The total number of conversations during 1906 amounted to 269,917,280, and of these special charges were paid for 10,793,880 conversations. The number of express conversations amounted to 834,211, and of night conversations to 266,926. The increase in conversations as compared with the previous year amounted to 18.3 per cent. Stockholm heads the list of conversations with 46,112,686, while Gothenburg has 32,397,566 and Malmö 13,030,361. The telephone conversations with foreign countries were: With Norway, 80,415; with Denmark, 114,002, and with Germany, 5,164. The receipts from subscriptions and entrance fees amounted to 4,547,446 kr., or £252,000 (4,132,288 kr. the previous year), and from charges for conversations to 3,460,950 kr., or £192,000 (2,898,518 kr. the previous year). The aggregate cost of the Swedish state telephone since its first beginning in 1881 up to the end of 1906 amounts to an aggregate of 36,214,552 kr., or £2,012,000. The expenditure rose from the modest 400 kr. the first year to the highest figures for any year (1902)—*viz.*: 3,416,750 kr., or nearly £190,000.

For the year 1908 it is, however, proposed to expend 5,000,000 kr., or £277,000. It is under contemplation to install about seventy new lines, and to erect 176 new central stations, and the calculated expenditure for 1908 is evenly divided between the interurban and the local lines. —*Engineering (London)*.

The Roma Civita Castellana Single-Phase Railway.

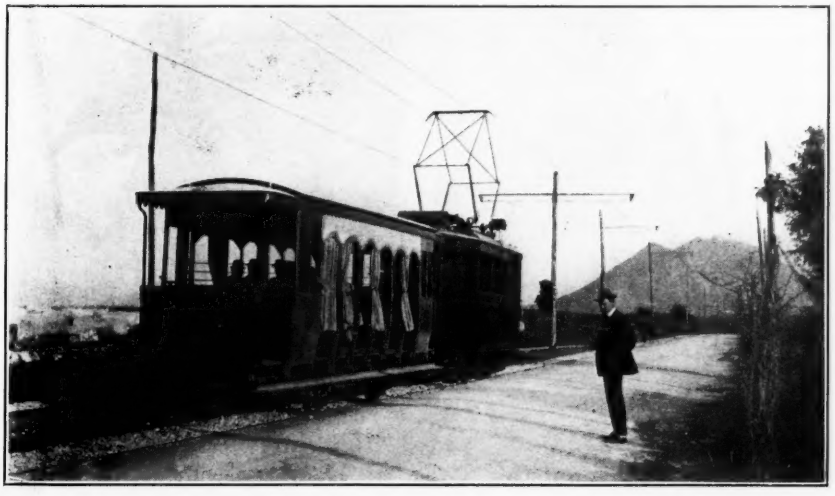
By B. F. Hirschauer.

THE Roma Civita Castellana Railway is the first single-phase traction installation carried out by the Société Anonyme Westinghouse on the Continent, and also the first single-phase railway in Italy.

The length of the line is thirty-five miles, 2.7 miles of which are for urban service and 32.3 miles for suburban service on the public road *via* Flaminia.

This line will most probably extend later on over the whole north region of Rome between the Tiber and the Viterbo Railway line. This region, containing an agricultural zone of 125,000 acres and a population of 25,000 inhabitants, had no easy and economical means of communication. The service for passengers was made by horses or oxen. The nearest railway was the Viterbo-Roma line, situated at a mean distance of fifteen miles from the centre of the region served by this new electric railway, and the Roma-Florence Railway at a distance of only seven and a half miles, but situated on the other side of the Tiber upon which there are only the Castel Jiubileo bridge near Roma and the Grillo bridge, twelve miles up the river.

Now the passenger service with this new electric railway will be secured by motor-cars and trailers and the freight service by electric locomotives. For the urban service there will be a train every fifteen minutes; for the suburban service four trains a day will run in both directions.



A Train on the Roma Civita Castellana Single-Phase Electric Line.

The profile of the line comprises a first part of about eight miles, situated along the Tiber, practically on level. There is then a continuous grade up to a height of

A Station, Showing Track and Trolley Suspension, Roma Civita Castellana Single-Phase Electric Line.

850 feet for a distance of 9.3 miles to reach Castel Nuovo, which is the culminating point of the whole line. The road then goes down nearly to its end, where there is a stiff gradient to get into Civita Castellana, which is situated on an isolated mountain. The grades vary between 1.5 to four per cent, and the maximum gradient is of 7.2 per cent for about 1,600 feet, entering Civita Castellana.

The gauge of the line is one metre (39.37 inches). In the suburban part the line is made of Vignole type rails, forty feet long, weighing forty-two pounds per yard. They are fixed on rectangular sleepers of 4.8 inches by 7.2 inches cross-section and 5.85 feet long. In the urban part, Broca type rails, weighing fifty pounds per yard, are employed. These rails are electrically connected by flat bonds placed under fish-plates of the Chicago type, having a section of 200,000 circular mils.

The electric equipment of the line is divided into two distinct parts: one for high tension and the other for low tension. The high-tension, or 6,500-volt, part begins at the generating station, which is situated three miles from Rome, and goes up to the end of the line at Civita Castellana, a distance of twenty-six miles. For the urban part, from the generating station up to the other end of the line at Piazza della Liberta, in Rome, the tension is only 600 volts.

HIGH-TENSION SECTION.

The high-tension line is composed simply of a 200,000-circular-mil copper wire without feeders, this section having been found sufficient for the service expected. The most unfavorable condition which can be imposed is the simultaneous running of two trains on the 4.7 and 7.2 per cent grades respectively. The power loss will be then slightly less than ten per cent, to raise to 11.5 per cent if a start is made on the 7.2 grade.

The trolley wire is suspended, over the whole length of the line, 19.5 feet above the level of the track, from angle-iron brackets fastened to wooden poles. These poles are of chestnut and have a diameter of eleven inches at the base. In the straight portion of the line they are placed at a maximum distance of 125 feet and in the curves at a distance varying from forty to 110 feet, according to the radius, and they are all set in concrete.

The principles adopted by the Société Anonyme Westinghouse in the establishment of this line may be summarized thus:

1. The line has great flexibility to prevent the trolley from shaking.

2. The line is provided with a double safety arrangement, preventing the trolley wire from falling in case of fracture and

making it dead as soon as the rupture takes place.

3. Switches and sections have been combined by means of special apparatus.

4. The insulation of the line is double, each being sufficient to withstand the voltage of distribution.

To reduce as much as possible the expense of first installation, the line has been equipped with safety devices only at the points of suspension; and only on entering Civita Castellana has the catenary construction been adopted.

The trolley wire has two lateral grooves and is supported by a strong clamp fixed to a flat transverse base of iron, of about three feet long in the straight portion of the line and of five and one-half feet in the curves. A galvanized steel cable, composed of seven strands, connects this suspension first to an isolating ball, then to a heavy insulator, both of porcelain, and able to withstand a tension of 30,000 volts. It will be noticed that by the system employed the line can not fall should a porcelain insulator break, on account of the interlocking metallic parts of these insulators.

The danger which would arise from the falling of a line wire has also been reduced to a minimum; the part more exposed to wear and tear being the point of suspension, a supplementary suspension has been provided, made of two small clamps fastened to the trolley wire about twenty-eight inches from each other and connected together by a steel cable supported upon the main suspension clamp. If a rupture occurs in an intermediate point a special device automatically and instantaneously breaks the line circuit. This device consists of a pilot wire of phosphor bronze running all along the line and connected at one of its ends to the trolley wire at the end of the line, and the other end, at the generating station, to a maximum and minimum release switch which operates when there is an overload or short-circuit, or when the line is broken.

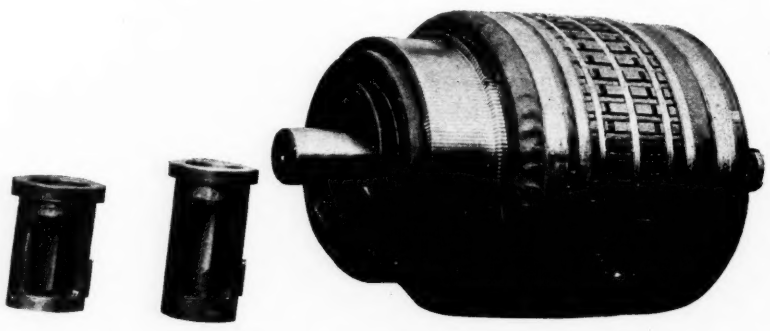
The catenary suspension is constructed in the following way: A galvanized steel cable 0.8 inch in diameter, supported by a heavy porcelain insulator fixed on the bracket, is suspended over the trolley wire and is connected to the latter every ten feet by means of flexible hangers of special design.

On each side of these main insulators there are, in the safety wire, other porcelain insulators, so as to secure the double insulation of the system from the ground. As the attachments of the cable to these insulators have the greatest wear and tear, they have been specially calculated with a factor of safety of ten.

The line is constructed for a bow trolley, and is stretched in zigzag so as to allow an even wear of the trolley contactor. The great elasticity of the line as well as its well-designed arrangement in the curves prevents any arcing, a point which is worthy of consideration, as the trolley-wire tension is 6,000 volts.

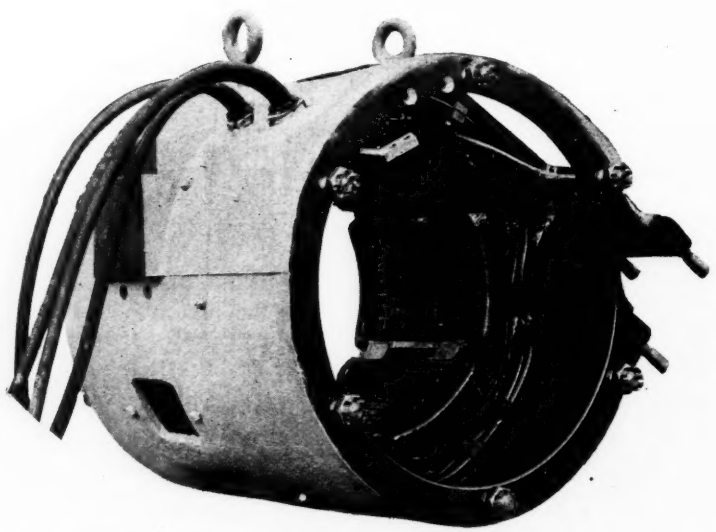
The bow trolley is the only current-collecting device which fulfils this desideratum, as it can not get out of contact even at the greatest speeds, and it does not wear the trolley wire heavily. For a service requiring a small current the sliding contactor of aluminum, greased, exerts very light friction and it will not produce a flat surface in the trolley wire of more than one-tenth of an inch, corresponding to an insignificant diminution of the wire section.

Switches at crossing have been made by disposing the wires so that the trolley can pass easily from one to the other. The only peculiarity they present is that the two wires are insulated from each other by spheres of porcelain and are connected in series by a return wire of the same cross-section as the trolley wire. This disposition was necessary so as to have but one circuit; thus the trolley wire of each track is protected in case of rupture of the pilot wire.



ARMATURE OF FORTY-HORSE-POWER SINGLE-PHASE MOTOR ON ROMA CIVITA CASTELLANA LINE.

The line is sectioned in ten places, at the neighborhood of the stations, and the several sections are electrically connected by means of interruptors of the horn type. The whole arrangement is maintained by two cross-bars at their tops, the two line wires are connected by means of two heavy porcelain insulators; a rigid section ten feet long insures the passage of the bow trolley from one section to the other.



STATOR OF FORTY-HORSE-POWER SINGLE-PHASE MOTOR ON ROMA CIVITA CASTELLANA LINE.

The two sections of the line are insulated one from the other by two porcelain bell insulators. They are also insulated from the dead section, the latter being itself doubly insulated from the ground, securing thus the passage of the trolley

without jar and without connecting the two sections in parallel.

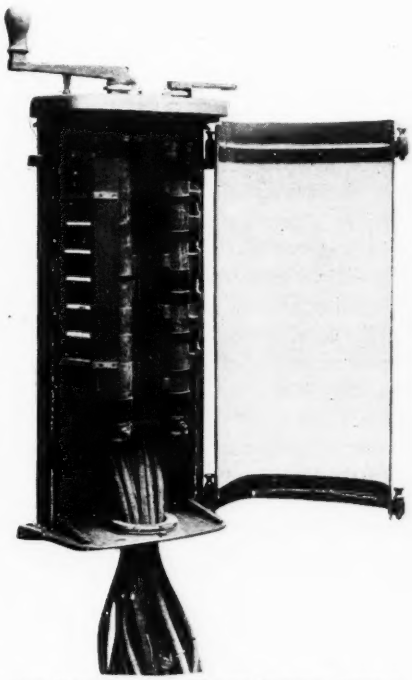
For the passage from the high to the low-tension section the system is analogous, but a special device automatically operates a switch on the car as soon as the trolley passes under the neutral section. The transformer of the equipment is thus always properly connected for the tension of the section as it enters it; all danger of burning the apparatus when passing from the low to the high tension is thus avoided.

Each section is protected by a lightning arrester of the horn type connected to the earth through a liquid resistance, and the line is also provided with a double anchor system.

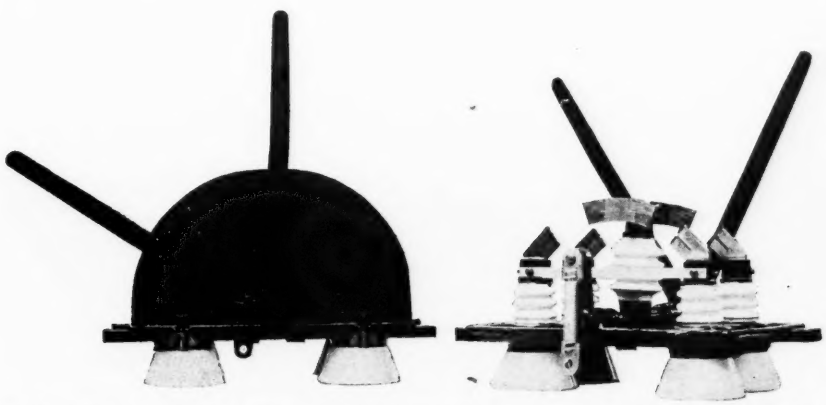
LOW-TENSION PART.

The urban line operates at 600 volts and is supplied through a copper wire of 240,000 circular mils, supported by drawn steel poles of the Manesmann type.

The same principles as for the high-tension section have been adopted in the construction of this section, with the exception of the porcelain insulators, which have been replaced by ambroïne insulators similar to those used for direct-current trolley lines. To one interesting point, however, reference must be made: this is the crossing of this section with one line of the Rome Tramways, a 500-volt, direct-current system using an ordinary wheel trolley. It was necessary to design a type of crossing giving the necessary insulation and operating well with the bow trolley.



TWO-MOTOR, FORTY-HORSE-POWER, SINGLE-PHASE CONTROLLER.



TWO-WAY SWITCH FOR CHANGE-OVER FROM HIGH TENSION TO LOW TENSION AND VICE VERSA.

The direct-current trolley wire runs inside a small channel treated with paraffine, in which the wire is fastened by means of ambroïne clamps. The trolley wheel passes progressively from the height of its wire to that of the edges of the channel by means of two straps fastened to the trolley wire at a small distance from the crossing. The two wires cross each other at an angle of forty-five degrees and the passage of the bow trolley from one side to the other of the direct-current wire is made easily, as the bow trolley touches the second edges of this channel before it has left the other.

ROLLING STOCK.

The motor-cars are twenty-three feet long by six and a half feet wide and are arranged to seat eighteen passengers and carry ten standing on each platform.

The trucks have two axles, six feet apart, each driven by a forty-horse-power compensated, single-phase series motor for 260 volts, twenty-five cycles.

The weight of each car loaded is about twelve tons. They will operate normally with a trailer weighing eight tons, and carrying an equal number of passengers, at a speed of nineteen miles an hour, this speed being the maximum allowed by the Italian laws for railways on public roads.

At full load, the motors run at 630 revolutions per minute and the gear ratio is 14/76. The reduction of the trolley wire tension to that at the motor terminals is made by an auto-transformer on the motor-cars, one terminal of which is connected to the line and the other to the ground. The potential of its windings varies, therefore, from zero up to that of the line. The system of control consists in connecting the motors to different voltage taps of the transformer secondary windings. The speed regulation is thus obtained without rheostatic losses. The motors are normally connected in parallel, the series-parallel system of control being in this case unnecessary.

To avoid short-circuiting the successive sections of the auto-transformer at the moment of the passage from one tap to the other, a preventive coil is employed, which equalizes the voltage of the short-circuited turns. This coil prevents the breaking of the current, and the energy consumed in it is very small.

The controllers are of the drum type, resembling closely those for direct-current work. Thy have five leads to the auto-transformer. The current for the motors is taken from a point midway of the preventive coil so as to draw an equal amount of current from the two leads of the auto-transformer. By passing from one lead to the next following the voltage is gradually raised from its lower to its higher value without interruption of the current supplying the motors.

With this system of control the heaviest current can be handled without danger, and the motor can run the car at any speed for any length of time, each step of the controller corresponding to an economical running position.

The high-tension circuit between the auto-transformer and the trolley is a cable enclosed in a brass tube. A fusible cut-out protects the apparatus against any overload or short-circuit, and a horn-type lightning arrester, with magnetic blow-out, protects it against static discharges.

The trolley contactor is made in two pieces operated by springs, both contributing to secure an even pressure of the trolley upon the wire, and to maintain a good contact continuously.

The trolley is made of a drawn steel tube with a rubbing contact of aluminum,

3.25 feet long, and a flat part five inches wide. The central part has a width of three inches and is formed by a strap of aluminum 0.2 inch thick, separated from the lateral straps by iron grooves which are normally full of grease and graphite.

The raising of the whole system, as well as the small contact bow, is effected by compressed air working in a cylinder with two pistons. The pressure of the trolley wire is regulated by springs and the reversing of the contact is made automatically when the car starts. The whole system is supported on four heavy porcelain insulators.

The compressed air necessary to maintain the trolley in contact with the line is drawn from the reservoirs supplying the air for the operation of the Westinghouse air-brakes fitted to the cars. This air is furnished by a compressor driven by a single-phase motor placed under the car.

Engineering as a Life Work.

An address on engineering as a life work was delivered by Professor H. H. Norris, of Cornell University, Ithaca, N. Y., before the students of Purdue University, January 27. Professor Norris first defined engineering as the industrial application of physical principles by designing and constructing machines and other devices for specific purposes, and by selecting and arranging such apparatus to produce commercial results of a maximum efficiency. Engineering to the individual may mean a business, a profession or a trade; properly it should be all of them. The community has a right to expect qualities of leadership from technical graduates. They should be willing to accept responsibility, thorough, and able to see the true relations of things. The student should realize that the technical training is not primarily to make its recipients better livings, but to afford them opportunities for efficient service.

Locomotives Supply Steam for a Central Station.

An interesting emergency steam plant is described briefly in the *Electrical Engineer*, London. It becoming necessary, a short time ago, to have certain repairs made to the boiler equipment of the Marylebone electric power station, London, four modern locomotives were secured. These were drawn up by the side of the building and pipes carried from the domes to the engine room. Steam was supplied from these locomotives while the repairs and cleaning to the station and boiler equipment were being carried out.

The Coal Industry in 1907.

The United States Geological Survey announces a production of between 450,000,000 and 460,000,000 short tons of coal in the United States, or an increase of ten per cent over the output for 1906, according to E. W. Parker, coal expert and chief statistician of the Survey. The following is abstracted from a bulletin recently issued by the Survey and will be found of interest to all concerned with the coal-fuel problem:

The most notable increase was made in the production of Pennsylvania anthracite, in which a gain of over twenty per cent was recorded, if the shipments reported by the Bureau of Anthracite Coal Statistics may be accepted as indicative of the total production; and as the shipments amounted to more than eighty-five per cent of the total production, such an assumption is not unreasonable. The shipments of anthracite in 1907 amounted to 67,109,393 long tons, as against 55,696,595 long tons in 1906. This would indicate a total production for the year of approximately 76,366,000 long tons, or about 85,840,000 short tons.

An interesting feature in connection with the production of anthracite in 1907 was the lack of any effect on the trade from the panic which occurred in October and continued until the end of the year. Not only did the shipments of anthracite continue throughout this period practically without interruption, but the records show that the shipments for November were larger than those of any other November in the history of the trade, while those for October were the largest recorded for any single month in the last four years. This condition illustrates the extent to which anthracite has been eliminated from industrial uses and shows that practically the entire production is consumed for domestic purposes.

Another interesting feature shown by the anthracite statistics for 1907 is the steadying influence on the trade of the policy adopted a few years ago by the coal-mining companies in reducing prices in the summer months. The shipments (excluding a February of twenty-eight days) ranged from 5,249,946 long tons in January to 6,015,851 long tons in October, and the average monthly shipments were not quite 5,600,000 tons. These figures indicate that the mines were operated with remarkable steadiness from month to month and that the transportation was also evenly distributed throughout the year.

The production of bituminous coal can not be estimated as closely as that of anthracite, for unfortunately there is no such reliable method of arriving at the total; but letters received by the Survey from a number of the larger operators and from state officials indicate that the output of bituminous coal in 1907 exceeded that of the previous year by seven to ten per cent. The increases were rather unevenly distributed and were influenced by several causes. In the Eastern States, where large quantities of bituminous coal are used in coke making and for other industrial purposes, the trade felt heavily the financial stress of the last three months of the year, and locally this effect was so pronounced that increases recorded during the first nine months were to a large extent wiped out. Had it not been for this disturbance in financial circles the production of bituminous coal in 1907 would probably have shown an increase almost comparable with the gain in anthracite production. It is almost certain that the increase would have amounted to about fifteen per cent, the total output being between 390,000,000 and 400,000,000 tons. As it is the output will probably be about 25,000,000 tons short of that figure.

The shortage of car supply, of which almost constant complaint has been heard for the last few years, continued during the first nine months of 1907, and owing to the demands for and high prices paid to labor in other lines of industry, miners and other workers in the bituminous coal-mining districts were scarce. After October, however, the supply of both cars and labor was plentiful. As compared with conditions in 1906, the transportation facilities were somewhat improved. It is probable that if sufficient cars could have been furnished to meet all the requirements of the producers, the output would have been pushed far in excess of the demand, and the usual demoralization attendant on such a condition would have resulted.

It is not possible at this time to give definitely the order of producing states; but owing to the fact that West Virginia was more seriously affected by the financial flurry than was her rival state Illinois, it is not improbable that the completed statistics of production may show that Illinois has regained the second place (next to Pennsylvania) that she lost in 1906 through the suspension of mining during the spring months, and that West Virginia will once more be third in rank.

LORD KELVIN AS A SCIENTIST.[1]

BY EDWARD L. NICHOLS.

"It is often said, and truly, that we are unable to estimate the value of our contemporaries, or to assign to them their proper position in the roll of fame. Those who are most widely and favorably known in their own time are frequently supplanted in the judgment of later generations by others who receive but little or no recognition during their lives. Occasionally, however, there appears a man of genius, the value of whose attainments can scarcely be questioned, and the permanency of whose position seems assured. Kelvin was one of these.

"It was said of Helmholtz[2] that he was one of the greatest physicists, one of the most accomplished physiologists and one of the most accomplished mathematicians of the century. Just as truly we may say of Kelvin that he was one of the greatest physicists, one of the most skilful mathematicians and one of the most fertile and ingenious of the inventors of his time.

"Lord Kelvin was born in Belfast, Ireland, on June 26, 1824. His father, James Thomson, was a North of Ireland man of the sturdy Scotch-Irish stock. He had been educated at Glasgow. He was a school teacher in Belfast, and it was in that city that his two sons, James Thomson and William Thomson, first saw the light.

"From 1832 James Thomson, Sr., was professor of mathematics at Glasgow, and there the two boys had their education in an environment fitted early to familiarize them with mathematical and scientific subjects, and to develop whatever latent powers they might possess. William was precocious, and at an age when boys, at least in our day, are thinking of entering college he was graduated from the University of Glasgow and went to Cambridge for further studies. There he distinguished himself in mathematics, and in 1841, when he was seventeen years old, published the first of a series of papers in the *Cambridge Mathematical Journal*. At Cambridge he was a pupil of George Gabriel Stokes, or more properly a companion, for he speaks of learning solar and stellar chemistry from him while they wandered together among the colleges.[3] Just what passed between these two young fellows on that subject, nearly twenty years before the appearance of the work of Kirchhoff and Bunsen it would indeed be interesting to know. From Cambridge, where his powers as a mathematical physicist were rapidly developed, Thomson went to Paris and worked for some months in the laboratory of Regnault, one of the accomplished experimental physicists of that time.

"In 1846 William Thomson became professor of physics at the University of Glasgow, which position he held almost to the end of his very long and active life. His brother James was subsequently appointed professor of applied mathematics and engineering in the same institution. The two, who were very like each other in character and in intellectual endowment, were frequently engaged upon similar problems. In 1851 William Thomson was elected to the Royal Society; in 1866 he was knighted and became Sir William Thomson; in 1892 he was raised to the peerage and took the title of Lord Kelvin.

"Kelvin was a man of wide interests in science, not a student of electricity merely, nor of mechanics, nor of heat, nor of sound and light, but of all of these, with many fruitful excursions into the fields of astronomy and geophysics on the one hand and of navigation engineering on the other. Owing, perhaps, to his early training in mathematics, and to the school in which he was brought up, his tendency was always to work from theory to experiment, seeking by the latter to verify the conclusions of his analysis. A man who naturally does this, however much experimental work he may perform, is to be classed as a theoretical physicist in contradistinction to those whose interests are primarily in phenomena, and who use theory to explain and elucidate what they observe.

"The period from 1841, when young William Thomson wrote his first papers, to 1907, when at the age of eighty-three he was still an active contributor to scientific literature, has been incomparably the most fertile epoch in the history of science and industry. Consider the material world of 1841:

"The railway had only just begun to displace the stage coach; there were a few ocean-going steamships, but most travelers crossed the ocean in sailing vessels; John Stephenson's attempt to introduce street railways in New York had been made and abandoned; there were as yet no street cars, even with horses as the motive power in any city. The conception of electric transmission of intelligence had been in men's minds for nearly a century, and a practical telegraph line had been constructed by Wilhelm Weber, and Gauss, the astronomer, in Göttingen. This line connected the observatory with the physical laboratory and had been in successful operation for five years. Railways, however, which were coming in, made the telegraph a public necessity, and in England, in 1840, Wheatstone and Cooke were installing their so-called A B C system. In this country Morse was busy with the same problem, but it was not until 1844 that the line from Baltimore to Washington was erected, and telegraphy became a practical thing in America. In a few of the largest cities only had gas come into use for street lighting; petroleum had not supplanted whale oil and candles for household illumination. The arc lamp had long before been invented by Davy, but electric lighting as a public utility had yet forty years to wait. A generation of electricians and inventors (Gramme and Siemens, Jablochkoff and Swan, Edison, Weston, Brush and a host of others) was yet to spend years of ceaseless toil in the development of that art, and of the other great electrical industries that the dynamo and motor have made possible. The airship was a dream of the visionary; the telephone not even yet a dream. Thirty-six years later the latter was to burst in a night on an unprepared and unexpecting world—essentially complete and ready for service. The airship was much longer to remain a dream, and only in these later days, after much cost in human lives and endeavor, does it seem to be nearing realization. These and a thousand other things, skyscrapers and elevators, trolley roads above and below ground, stock-tickers and typewriters, submarine boats and steam turbines, motor-boats and motor-cars, wireless telegraphs and all that render life to-day at once more luxurious, more strenuous and more complicated, were dreams, or less than dreams, in the year of 1841.

"It is even more difficult to realize the conditions of science at that time than to appreciate the changes that have taken place in the industrial world. Nineteen years were yet to elapse before the publication of Darwin's 'Origin of Species.' Pasteur was not yet. Brewster was still fighting his losing battle against the undulatory theory of light. In electricity, Coulomb and Oersted and Ohm, Arago and Ampere had paved the way to a new order of things, but the labors of Faraday in England and of Joseph Henry in this country were but just begun. Heat was

[1] From an address delivered at the memorial exercises in honor of Lord Kelvin, held by the American Institute of Electrical Engineers in New York city, January 11.

[2] Clifford, "Seeing and Thinking," p. 18.

[3] Kelvin, *Nature*, 67, p. 387.

still regarded as a subtle fluid, and nine years were still to elapse before the appearance of Helmholtz's paper on the 'Conservation of Energy.' An era of extraordinary activity, however, was about to begin, during which science was to revolutionize the industrial methods of the world and to be herself revolutionized.

"In both revolutions Kelvin was to have an important part. Science to him was the endeavor to give precise mathematical expression to relations perceived, and thus to bring to light relations hidden and obscure. He sought likewise to comprehend definitely the mechanism involved in physical processes. Where the mechanism was not capable of being directly observed he strove to imagine one. With him computation was a passion, observation of secondary interest. He was always calculating, and few men I suppose have ever applied mathematics to a greater variety of subjects. The heat of the sun, the age of the earth, the size of atoms, the density of the luminiferous ether, the power of a cubic mile of sunshine, the mechanical energy of the solar system, the annual loss of heat by radiation from the earth, the retardation due to tides; these and innumerable other problems engaged him. Even his popular addresses, where all higher mathematics was excluded, teem with numerical data. He was no compiler of statistics. He gave out the results of his own computation in illustration of his subject. In such cases he was wont to express himself in the homely British measures—capillary forces, in tons, to the square inch and the like—but at the same time he was an enthusiastic supporter of the metric system, and was chiefly instrumental in the establishment and adoption of the centimetre-gramme-second system of units. To a Philadelphia audience in 1884 he said:

"'You in this country are subjected to the British system in weights and measures; you use the foot, inch and yard. I am obliged to use that system, but I apologize to you for doing so, because it is inconvenient. I look upon our English system as a wickedly brain-destroying piece of bondage under which we suffer. The reason why we continue to use it is the imaginary difficulty of making the change and nothing else; but I do not think in America that any such difficulty should stand in the way of adopting so splendidly useful a reform.'

"Kelvin was a most prolific writer, and his productiveness lasted from his student days at Cambridge in 1841 until the year of his death in 1907. He contributed over 300 papers to some thirty different journals and transactions. The list of titles is a catalogue of nearly everything about which the world of physics was thinking, during the long period of his scientific activity. Often it was but a passing, though always a significant and suggestive, thought which he presented, but certain great subjects were to him themes of lifelong interest, and to these he continually returned with new contributions to our knowledge. With the doctrine of energy, in the development of which he was long a co-worker with Joule, and the science of thermodynamics which has grown out of that doctrine; with the mathematical theories of heat and electricity; with the theory of wave motion and especially of water waves, and with nineteenth century speculation concerning the constitution of matter, his name will ever be associated. His work in any one of these fields of investigation would have placed him in the first rank and insured him a lasting reputation. Taken altogether, they justify the universal acclamation of him as the foremost man of science of his time.

"In 1854 Cyrus Field appeared in England with a proposal for a transatlantic cable. The great expense involved rendered the question of great importance whether transmission was practicable to such distances, and, if possible, the conditions under which success was to be expected. There was no previous experience upon which to base opinions, and most of the electricians of that time were as ill-equipped to consider the question from the theoretical point of view as were most of the practical men forty years later, when suddenly confronted with the change from direct to alternating-current systems for light and power. Kelvin, however, had already considered from the mathematical standpoint the conditions existing in a circuit containing capacity and inductance. Three years before, his analysis was sufficiently advanced to enable him to forecast the existence of the phenomenon of the oscillatory discharge, and to state the law of retardation. He was almost the only man in England capable of giving a definite answer to many of the questions involved in long-distance transmission of signals through cables.

"The history of his connection with the transatlantic service is well known. We know that the breaking down of the first cable in 1858 was due to failure to heed his warning, and that the ultimate success of the scheme was very largely the result of his mathematical skill and rare mechanical insight. It was in recognition of these practical services as well as of his eminence as a man of science that he was knighted in 1866.

"Of his career as an electrical engineer and of his contributions to the art of navigation it is not my province to speak. Permit me, however, to note the very unusual circumstance that although a considerable portion of his time was for many years given to technical work, his output as an engineer was but a by-product. He was not thereby diverted from the consideration of the most abstruse and difficult phases of pure science, but continued to contribute with unabated ardor and success to our knowledge of physical theory, to the very end of his long life. Only last summer at the meeting of the British Association he was able to take an animated and interested part in the discussions of the mathematical and physical section, and although he had a few years ago resigned his professorship at Glasgow, he may be said to have died in harness, since his last illness a few days ago was brought on by cold, due to his experimenting in the unheated hallways of his country house in Scotland.

"Kelvin was keenly appreciative of the scientific and technical work of America. Of his visit in 1876 he spoke in the following glowing terms on September 7 of that year:[1]

"'I came home, indeed, vividly impressed with much that I had seen both in the great exhibition in Philadelphia and out of it; showing the truest scientific spirit and devotion, the originality, the inventiveness, the patient, persevering thoroughness of work, the appreciativeness and the generous open-mindedness and sympathy, from which the great things of science come. I wish I could speak to you of the veteran Henry, generous rival of Faraday in electromagnetic discovery; of Peirce, the founder of high mathematics in America; of Bache, and of the splendid heritage he has left to America and to the world in the United States Coast Survey; of the great school of astronomers which followed—Gould, Newton, Newcomb, Watson, Young, Alvan Clark, Rutherford, Draper (father and son); of Commander Belknap and his great exploration of the Pacific depths by pianoforte wire with imperfect apparatus supplied from Glasgow, out of which he forced a success in his own way; of Captain Sigsbee, who followed with like fervor and resolution, and made further improve-

[1] Kelvin: Address to the Mathematical and Physical section of the British Association, 1876.

ments in the apparatus by which he has done marvels of easy, quick and sure deep-sea soundings in his little surveying ship Blake.

"'In the United States telegraphic department I saw and heard Elisha Gray's splendidly worked out electric telephone actually sounding four messages simultaneously on the Morse code, and clearly capable of doing yet four times as many with very moderate improvements of detail; and I saw Edison's automatic telegraph delivering 1,015 words in fifty-seven seconds—this done by the long-neglected electrochemical method of Bain, long ago condemned in England to the helot work of recording from a relay, and then turned adrift as needlessly delicate for that. In the Canadian Department I heard "To be or not to be—there's the rub," through an electric telegraph wire; but scorning monosyllables, the electric articulation rose to higher flights, and gave me passages taken at random from the New York newspapers. All this my own ears heard, spoken to me with unmistakable distinctness by the thin circular disc armature of just such another little electromagnet as this which I hold in my hand. The words were shouted with a clear and loud voice by my colleague-judge, Professor Watson, at the far end of the telegraph wire, holding his mouth close to a stretched membrane, such as you see before you here, carrying a little piece of soft iron, which was thus made to perform in the neighborhood of an electromagnet in circuit with the line, motions proportional to the sonorific motions of the air. This, the greatest by far of all the marvels of the electric telegraph, is due to a young countryman of our own, Mr. Graham Bell, of Edinburgh and Montreal and Boston, now becoming a naturalized citizen of the United States. Who can but admire the hardihood of invention which devised such very slight means to realize the mathematical conception that if electricity is to convey all the delicacies of quality which distinguish articulate speech, the strength of its current must vary continuously and as nearly as may be in simple proportion to the velocity of a particle of air engaged in constituting the sound?'

"In 1884 Kelvin attended the British Association meeting in Montreal, and tarried to deliver before a distinguished and appreciative audience in Baltimore the extraordinary course of lectures on molecular dynamics which twenty years later he published in book form. In 1897 the Toronto meeting of the association brought him across the water once more, and it was here that he read his striking paper on the 'Fuel Supply and Air Supply of the World'; the suggestion being that free oxygen is the result of plant action, and that cessation of life is more likely to come from depletion of the air than from lack of fuel. Upon his last visit to the United States in 1902 he showed a spirit unconquered by old age, an enthusiasm for all things scientific, and an interest in things technical, as vivid and trenchant as that which had characterized his younger days. Seeing a gang of twenty-four small direct-current generators operated in series for high-tension experiments in the laboratory at Cornell, I remember that he advocated the direct current for long-distance transmission in preference to alternating current—a suggestion which then met with little favor, at least in this country, but which is now being worked out on a practical scale in Switzerland.

"Kelvin was so familiar a figure to engineers and physicists in this country that I need not attempt to describe him. Many of you will remember the spare, wiry form, almost frail as to physique, but full of life and imbued with an almost boyish eagerness. To my mind his most striking characteristic was an unostentatious simplicity; the simplicity which one remembers in men such as Heinrich Hertz and in Lorentz, and which happily we find so frequently in great men, that it may fairly be termed the typical simplicity of genius. With this simplicity was combined a certain practicality; the practicality of his race. I do not know, but I suspect, that Kelvin would have regarded Niagara fully harnessed to the service of man, a more beautiful and inspiring sight than the original unchained Niagara of the wilderness. I well remember that years ago when the æsthetically inclined protested against the unsightliness of overhead wires he remarked that the time would come when the network of wires across the sky would be regarded a fit subject for the rhapsodies of the poets.

"Combined again with these personal attributes was the supreme quality of kindliness; and to this I am able to bear direct personal testimony. In the winter of 1879 I was in Scotland, and ventured somewhat timorously to visit Kelvin's laboratory at the University of Glasgow; an unknown student on my way home from Germany with no claim upon him, and no recommendation save a certain enthusiasm for physics and a keen interest in the work which he was doing. I shall never forget the warm friendliness of my reception, nor the trouble he took to show me everything in the laboratory and workshops, nor the cordial hospitality of his household and that of his brother, James Thomson, the professor of engineering.

"Such was Lord Kelvin, physicist, mathematician, electrician, inventor, man of genius. He has passed from earth, and his fellow countrymen have paid him their highest tributes—a resting place in Westminster Abbey. May not we, his cousins across the sea, gathered in commemoration of him, and of his services to mankind, say, fittingly, of him what he himself said, in his tribute to his fellow physicist and friend, Sir George Stokes:

"'The world is poorer through his death and we who knew him feel the sorrow of bereavement.'"[1]

Metric System in Denmark.

United States Consul-General F. R. Mower, of Copenhagen, reports that the metric system is to be adopted in Denmark in place of the present system of weights and measures. A law for this purpose was passed at the last session of the Rigsdag, which was approved by the King on May 4, 1907. This provides that the unit of measure shall be the metre, and the unit of weight the kilogramme. The other weights and measures are to be derived from these units. The standards for this purpose are to be obtained from the Bureau of Weights and Standards, of Paris. The law is to go into force in Denmark whenever the King shall decide, for the payment of taxes and other obligations in which measuring and weighing instruments are used, not later than three years after its publication. Two years after that date the metric system must be used exclusively, with the exception of the apothecary's weights and measures and scales used for weighing precious stones.

The Toledo Railways and Light Company.

The annual report of the Toledo Railways and Light Company, Toledo, Ohio, for the year ended December 31, 1907, shows that the earnings for dividends on the $13,875,000 capital stock outstanding were equal to 2.27 per cent, the smallest amount available for dividends on the basis of this outstanding capital stock since 1902. President H. A. Everett states that the net results of the year's operations are unsatisfactory, owing to a combination of circumstances which will probably never again occur. The company looks forward to a prosperous year in 1908, not so much from anticipated growth in gross earnings as from a reduction in expenditures for capital account and operating charges.

During last year the company acquired control of the Toledo Gas, Electric and Heating Company, and took possession of the property on June 1.

[1] Lord Kelvin: "The Scientific Work of Sir George Stokes," *Nature*, 67, p. 337.

Commercial Importance of the Southern Appalachian and the White Mountain Watersheds.

In view of the interest shown in the proposed forest reservations in the Southern Appalachian and White Mountains, the report to the president of the Senate, Washington, by the secretary of agriculture, dealing with this subject, is valuable. In this the importance of these two forest districts is shown and also the effect which their destruction is having upon the neighboring lands and the rivers which rise in these mountains. It is stated that the minimum horse-power of the large rivers, beginning with the Potomac and including all those which rise in the Southern Appalachian, is 2,740,000, while the minimum for the six high-water months is a little less than 5,000,000. The Geological Survey estimates that fifty per cent of the indicated minimum, and probably more, is available for economic development. On this basis the rental of 1,330,000 horse-power at $20 a year would bring in an income of $27,000,000 annually. Taking in the same way fifty per cent of the power available for half a year, the total annual income would be $38,000,000.

This report gives maps showing the location of the proposed reservations and the following recommendations made by the secretary:

In view of the conditions described on the foregoing pages it is clear that the government should undertake without delay the acquisition of a definitely restricted amount of land in specified watersheds in the White Mountains and in the Southern Appalachians for the establishment of national forests.

In the White Mountains it is recommended that the government acquire an area of not to exceed 600,000 acres within the area designated on the accompanying map and so situated as to embrace as much as possible of the Presidential, Franconia, Sandwich and Carter-Moriah mountain ranges; that a limit of $6 per acre be fixed as the average price to be paid for cut-over lands; that an appropriation of $1,250,000 be made immediately available for such purchase; furthermore, that $250,000 additional be appropriated for the purchase of the timber in its present condition, surrounding the five important recreation points described elsewhere.

In the Southern Appalachians it is recommended that areas aggregating not more than 5,000,000 acres be purchased within the limits designated on the map accompanying the report, and distributed, as may seem advisable, over the higher watersheds of the following rivers: Potomac, James, Roanoke, Yadkin, Catawba, Broad, Saluda, Savannah, Chattahoochee, Coosa, Tennessee, New, Cumberland, Kentucky, Monongahela; that the limit of average price be fixed at $3.50 per acre, and that an appropriation of $3,500,000 be made immediately available to begin the purchases.

It is recommended also that the government adopt in both regions a policy of co-operation with timber-land owners in order to bring about the protection of private forests from fire and the general adoption of improved methods of cutting.

The Manufacture of Calcium Cyanamide.

The various sources of nitrogenous fertilizers are briefly discussed here by J. B. C. Kershaw, as are also the various processes for the fixation of nitrogen by means of the electric arc. The author then takes up at some length the Frank and Caro process for the fixation of nitrogen by the passage of this gas over heated calcium carbide. This process is now being carried out at large works at Piano d'Orta in Italy. Retorts containing powdered calcium carbide are heated to 1,100 degrees centigrade, when nitrogen is passed through. Chemical change takes place, which is represented by the following equation: $CaC_2 + 2N = CaCN_2 + C$. The calcium carbide required for the process is produced in the usual manner in electric furnaces of the resistance type. At Piano d'Orta it is secured from works in the neighborhood, and is not manufactured at the cyanamide factory. A modification of the original process has been made by Frank, in which lime and coke are used as the raw materials in place of calcium carbide. The reaction which takes place is represented by the following equation: $CaO + 2C + 2N = CaCN_2 + CO$. Carbon monoxide gas is given off from the retorts. The furnace proposed for this process consists of a brick chamber, eighteen feet long by nine feet high and nine feet wide. It contains an inner chamber with a perforated wall. This chamber is completely filled with crushed and mixed lime and coke. Electric heating is provided for by carbon electrodes, and nitrogen is passed under pressure into the chamber surrounding the furnace proper. The carbonic oxide gas escaping is drawn off from a vent pipe leading into the inner chamber. The nitrogen used for these processes may be obtained by passing air over heated copper or by the fractional distillation of liquid air. The latter method has been the most successful, as oxygen is secured as a by-product for which there is a sale. The furnace at present in use consists of a cylindrical iron retort packed with a crushed carbide and placed over the furnace. Nitrogen gas is passed into the retort under pressure and is absorbed, with a rise in temperature. When no more nitrogen is absorbed, the contents of the retort are withdrawn and allowed to cool in an inert atmosphere. The lumps of cyanamide are then crushed to a fine powder and packed in sacks. The present output of the works is 3,750 tons a year. There are six furnaces, each containing five retorts, in use, and extensions are being made. Some modifications of this process have been suggested, these being with a view to lowering the temperature at which the compound takes up nitrogen. Calcium chloride has this effect, but the resulting mixture is hygroscopic, since it contains the chloride in unchanged form. Calcium fluoride may be used in place of the chloride, overcoming the objectionable feature of the latter. There is a factory in operation at Westeregeln, Germany, where the first modification mentioned is being employed. The determining factor in the cost of cyanamide is the cost of the electrical power. One ton of nitrogen is obtained in the form of cyanamide with an expenditure of two kilowatt-years. The cost of power is said to be $10 a horse-power-year, and the cost of nitrogen from three-quarters to one and one-half cents a cubic metre. The power for compressing the air costs from one-half to three-quarters of a cent a kilowatt-hour.—*Electrician (London), January 24.*

New Washington Electric Railway.

Surveys for the Northern & Southern Electric Railway, for a line to the Columbia River from Kennewick to Waterville, have been filed in the United States Land Office at Kennewick, Wash. It is announced that construction will be begun early in the spring. Long stretches of right of way have already been secured. W. R. Rust, of Tacoma, Wash., is president; M. B. Haynes, vice-president; E. H. Guie, secretary, and H. K. Owens, chief engineer. The road will be a standard-gauge track, 126 miles in length, connecting with five transcontinental lines. Within sixty days the power plant at Priest Rapids will be completed, with a capacity of 20,000 horse-power. The new road will receive power from this plant.

LONDON STREET LIGHTING.

BY H. THURSTON OWENS.

The ELECTRICAL REVIEW of December 28, 1907, contained an abstract of an article printed in the December 6th number of the *Electrical Review*, London, by Mr. Haydn Harrison, entitled "The City Lighting." Mr. Harrison has had a number of tests made upon London streets lighted by different illuminants and endeavors to prove, by illumination curves, that one style is far superior to the others. His results have apparently given him great satisfaction, to judge by his closing statement: "It will be readily seen that the excellent illumination in Cannon street is due to the correct arrangement of the lamps; which arrangement not only conduces to the comfort of the public by the better lighting obtained, but also by withdrawing from their line of sight the powerful lamps necessary for the purpose."

Let us see how this happy result has been attained. There are on Cannon street long-burning flame arc lamps, suspended over the middle of the street, twenty-eight feet high, forty-six to the mile. Arc lamps are usually placed between fifteen and twenty feet high, rarely exceeding the latter figure, and Mr. Harrison has attempted to remedy one of the bad features of the flaming arc lamp, namely its bad effect upon the eyes, by placing them twenty-eight feet high. Even at this unusual height a person driving along the street would instinctively look at the lamps, and the result would be partial blindness immediately afterward.

The worst feature of this installation, however, is that it is not in keeping with the accepted theory of what is artistic in street lighting. A suspended lamp is never a thing of beauty, but flaming arcs having the appearance of a comet's tail, distended but luminous, and perilously near one's head, should certainly be enough to keep the "Old Lady of Threadneedle Street" awake nights.

The street which has been selected for the above test is in the heart of London and is near the "Bank" and the Royal Exchange, which are shown in Fig. 1.

Queen Victoria street, which is shown in Fig. 2, was also tested by Mr. Harrison, but the high-pressure mantle gas lamps in use did not show nearly as well on paper as the "Arabian Nights" effect on the neighboring thoroughfare.

That portion of the London public whose æsthetic tastes are highly developed will probably have something to say regarding the installation, and it is to be hoped that it will be more effective than the following statements have been in regard to lamp-posts:

"The street lamp-post is certainly a prominent object, but as a matter of fact nobody cares what its appearance is like, except, perhaps, the select few who devote the greater part of their time to grumbling in general."—Norton H. Humphreys, *The American Gas-Light Journal*, October 1, 1894.

"We are certainly not an artistic people. . . . Our lamp-posts and fittings 'give us away' as hopeless barbarians for whom art has no real attraction."—*Journal of Gas Lighting*, July 26, 1896.

The writer made an extremely short visit to London over a year ago, and the above statement, made in 1896, seemed to be true in 1906. There are a number of handsome installations, however, and one is shown in Fig. 3, this being Piccadilly,

FIG. 1.—BANK OF ENGLAND, LEFT CORNER, ROYAL EXCHANGE, CENTRE, LONDON, ENGLAND.

FIG. 2.—QUEEN VICTORIA STREET AND BLACKFRIARS BRIDGE, LONDON, ENGLAND.

FIG. 3.—PICCADILLY, LOOKING EAST FROM PARK LANE.

FIG. 4.—HOUSE OF PARLIAMENT, LONDON, ENGLAND.

looking east from Park Lane, where arc lamps with dense milky outer globes may be seen. They are placed opposite each other, about 100 feet apart, and there are additional lamps upon the aisles of safety at the street intersections.

Another unique installation is to be found under the shadow of "Big Ben," as shown in Fig. 4. Here clusters of mantle gas lamps, in great profusion, furnish the illumination.

The most noticeable feature was the lack of any uniformity as to either illuminants or posts, and a great variety of both are to be found.

These snapshots were taken by the writer to show London, and not lamp-posts, and in each a different lamp is found. This lack of uniformity was particularly noticeable after a previous visit to Paris, where the beautiful result is principally due to uniformity.

Illumination curves are necessary if one is to prove, by test, the results of illumination, but efficiency should only be considered after the artistic result has been attained.

Signals for Trolley-Car Lines.

A brief description is given in the *Tramway and Railway World* (London), January 2, of a number of American signaling systems for electric street railways and also of several systems which have been installed in Great Britain. The American systems described are those of the United States Electric Signaling Company, the Eureka system, and the Blake Signal and Manufacturing Company's system. The latter is really not a signaling system, but a means of enabling the car despatcher to establish communication with the car crews at different points on the line. This is accomplished by means of a number of pendulums having different periods of oscillation, which are set into action only when impulses of the proper frequency are sent over the signaling line. When the swing of any one pendulum has reached a certain amount, it trips a signal which stops the next car at that point. The first signaling system installed in Great Britain was that used at Dover. This is a single-track road with turn-outs. At each turn-out are two signals, which are operated by buttons pressed by the motorman before and after entering a section. At South Sea, the Harrison signal is used. This also is for single-track roads. At each turn-out there are two contacts on one trolley wire and one on the other. As the trolley wheel passes along the wire, it first makes contact at one point, which, by means of an electromagnet with a triple winding, throws the signal for the next section of track to safety, provided no car is on that section. The same circuit which drops this signal locks that one at the other end of the section in the danger position. As a car passes out of the turn-out the trolley wheel touches another contact which restores the signal just passed to danger and locks it in that position. As this car passes out of the section at the next turn-out it unlocks the signal at the last turn-out. Similar contacts on the turn-out trolley operate the signals in the reverse direction. A system has been installed by the Electric Tramway Equipment Company on the Swindon railways, in England. This is simple, consisting merely of groups of lamps controlled by two-way switches. The conductor throws a switch in one direction as he enters a section, which lights the lamps in that section. As he passes out he throws a switch at the other end, extinguishing the lamps. A system has been installed by Brecknell, Monroe & Rogers, on the Burton & Ashby Light Railway, England, and also at Bath, Bristol and other places. This method allows one car to follow another into a section, but, of course, prevents two cars from entering a section from opposite directions at the same time. A rotary switch is provided, which is operated when the trolley wheel comes in contact with a short section of wire placed beside the trolley wire. This moves the switch forward one step, lighting the lamps and indicating that a car is in that section. This prevents any other car from entering the section from the opposite direction, but a car following may enter the section, and in doing so it moves the rotary switch forward a second step. As the first car passes out of the section the trolley wheel touches a contact which revolves the rotary switch backward one step; but this still leaves the lamps lighted, as this switch will not be returned to the off position until the second car has passed out of the sections. Siemens Brothers & Company have installed a system at Pontypridd. In this the trolley wire is cut into sections which are fed from the far end. As each car enters a section the current which it draws through the trolley wire operates a switch at the far end which closes the contact in the signaling circuit, lighting the lamps. At the same moment the passage of a car into this section clears the signals of the section just left.

Stevens Institute of Technology.

At the last meeting of the board of trustees of Stevens Institute of Technology, Hoboken, N. J., Dr. Edward Weston was unanimously elected a permanent member of the board. Dr. Weston has always taken an active interest in the development of Stevens Institute, and much satisfaction is felt over his becoming thus officially identified with the work. The institute conferred the honorary degree of Doctor of Science on Dr. Weston in 1904.

The following itinerary has been arranged for the inspection trip of the senior class of 1908. This trip is in charge of Professor Albert F. Ganz, and the party assembled in the Pennsylvania depot in Jersey City at 2 P. M., February 10. On February 11 the party visited the Pennsylvania Railroad shops at Altoona, Pa.; on February 12, the National Tube Works at McKeesport and the Carnegie Steel Works at Homestead, Pa.; on February 13, the works of the Westinghouse Electric and Manufacturing Company and the Westinghouse Machine Company, at Pittsburg; on February 14, visits to local points of interest around Pittsburg; on February 15, the Lackawanna Steel Works and the converter stations of the Buffalo General Electric Company, and the transformer station of the Niagara Falls Power Company. On February 16 the hydraulic developments and transmission lines on the Canadian side of Niagara Falls will be visited. On February 17 the power-houses of the Niagara Falls Power Company, the Canadian Niagara Falls Power Company, the Ontario Power Company and the Toronto Power Company, at Niagara Falls, will be visited. On February 18 the power-house of the Niagara Falls Hydraulic and Manufacturing Company and the plant of the International Paper Company, at Niagara Falls, will be visited. February 19 and 20 will be spent at Schenectady, N. Y., visiting the works of the General Electric Company and the American Locomotive Company.

Seattle Branch, American Institute of Electrical Engineers.

Officers were elected by the Seattle (Wash.) branch of the American Institute of Electrical Engineers on January 18 at a meeting held in the Chamber of Commerce. The officers are: Chairman, John Harisberger; secretary, W. S. Wheeler; executive committee, C. E. Magnusson, W. S. Hoskins and A. S. Kalenborn.

BOOK REVIEWS.

"Cours d'Electricite." H. Pellat. Paris. Gauther-Villars. Paper. 290 pages. Illustrated. 6 by 10 inches. Price, 10 francs.

This is the third volume of the course in electricity conducted by Professor Pellat at the University of Paris. In it the study of electrolysis is taken up, the dissociation and other theories being fully explained. It is shown how these satisfy the well-known phenomena of electrolysis. Electro-capillarity is then discussed, and the use of this phenomena for measuring potentials is described. The ionization of gases and the modern theories of electricity and of electrical conduction are finally discussed critically.

"The Electric Furnace in Iron and Steel Production." J. B. C. Kershaw. New York. D. Van Nostrand Company. Cloth. 68 pages. Illustrated. 5½ by 8½ inches. Furnished by the ELECTRICAL REVIEW for $1.50.

Mr. Kershaw has performed a very acceptable service in bringing together here descriptions of those furnaces which have been used for the production of iron and steel. The first part is descriptive, and includes practically all types of furnace which have reached a stage of sufficient importance to warrant their introduction. The author then takes up the question of yields and costs, and presents all the information bearing on this side of the question which he has been able to bring together. An appendix contains a list of the British and American patents relating to this subject.

"Thomas Alva Edison." Francis Arthur Jones. New York. Thomas Y. Crowell & Company. Cloth. 362 pages. Illustrated. 5½ by 8½ inches. Furnished by the ELECTRICAL REVIEW for $2.

The author has brought together here a large amount of interesting information relating to Mr. Edison's active life. He gives a brief sketch of his boyhood and youth, and describes the experiences through which he passed before finally obtaining employment. The various stages in his advance are then described, each in detail, beginning with his work on the telegraph, following with the telephone, the incandescent electric lamp, the dynamo, phonograph, kinetoscope and other inventions. A great many anecdotes are worked into the text. In reading it one feels, however, that while the author has a deep veneration for Mr. Edison and his work, his appreciation for the latter is not always scientific. He emphasizes features not particularly essential and makes certain statements which indicate his ignorance regarding the work of other inventors. His story of the way in which Edison determined the volume of an incandescent lamp bulb by making a nest of tin boxes and pouring water out from the bulb into the largest of these and from this into the next until he found one which was just filled is an expanded variation of an old anecdote which is not improved in the new form.

"Engine Room Chemistry." Augustus H. Gill. New York. Hill Publishing Company. Cloth. 198 pages. Illustrated. 4¾ by 7 inches. Furnished by the ELECTRICAL REVIEW for $1.

During the last few years engineers have begun to realize the various advantages to be gained by applying chemical methods to certain parts of their work. This is particularly true of the purchase of coal, oil, paints and other similar supplies. In fact any material, the composition of which is specified, can be purchased most satisfactorily on a chemical specification. The purchaser then buys just what he wants and pays merely for the materials. In this little treatise Professor Gill takes up in an elementary way those fundamental chemical principles which must be understood by the student who intends to apply chemical methods of inspection and testing. He then discusses the combustion of fuels and their analysis, analysis of water, scale prevention and the study of oils—both mineral and vegetable. In each case clear instructions are given for carrying out the usual chemical tests of these materials.

"Continuous-Current Engineering." Alfred Hay. New York. D. Van Nostrand Company. Cloth. 328 pages. Illustrated. 5½ by 8½ inches. Furnished by the ELECTRICAL REVIEW for $2.50.

This is an introductory text-book to the study of continuous-current machinery. The author aims to present the matter in a simple way and instruct the reader in the principles upon which the machines operate, and describes the construction of motors, dynamos, batteries and measuring instruments. He assumes that the reader has an elementary knowledge of electricity and magnetism, and passes over this part of the subject very briefly. He then takes up the study of measuring instruments, both of the direct-reading and recording types. The principles of the dynamo and motor are discussed, methods of construction described and data are given relating to their design. In this part of the book some of the newer types of machines, such as the constant-current, variable-speed, train-lighting dynamo are described. A discussion of secondary cells then follows; then a study of various types of arc and incandescent lamps. The method of treatment is descriptive and mathematics is noticeably avoided.

"Electric Railways." Sydney W. Ashe. New York. D. Van Nostrand Company. Cloth. 282 pages. Illustrated. Furnished by the ELECTRICAL REVIEW for $2.50.

This is vol. ii of this treatise on electric railways; the first was prepared by Mr. Ashe in collaboration with J. D. Keiley and took up the rolling stock. In this Mr. Ashe considers the engineering preliminaries and direct-current substations. In the opening chapter the treatment is largely statistical, the conditions in various parts of the country having been studied and the averages obtained from these being used to determine the general features of a design for any particular situation. The author then takes up the various means proposed for selecting the electrical equipment, and describes graphical methods for preparing schedules. Passing into the study of power-house and substation location, the author first discusses the method proposed by C. W. Ricker for locating the power-houses. He then gives some summarized cost and data. Taking up next rotary converter substations, certain typical substations are described with considerable detail, wiring diagrams being given and all the apparatus being considered in turn. Directions for operating these stations follow. In the concluding chapters rotary converters, transformers and auxiliary substation apparatus are considered. This book contains a great deal of detailed information relating to electric railway design and operation.

"The Colorado Springs Lighting Controversy." Henry Floy. New York. Illuminating Engineering Publishing Company. Cloth. 328 pages. Illustrated. 6 by 9 inches. Furnished by the ELECTRICAL REVIEW for $4.

In this book are brought together all of the evidence and the exhibits brought out by the commission of experts which arbitrated the celebrated controversy between the city of Colorado Springs and the Pike's Peak Hydroelectric Company, of the same city. This controversy has become memorable because, for the first time, three important questions were passed upon in a judicial way. These are: The meaning of the phrase "an arc light of standard 2,000 candle-power," "the monetary damage accruing from the substitution of a different lamp than that previously used," and "the damage resulting from the failure to maintain the substituted lamps at their normal operating condition." Mr. Floy has performed a valuable service, not only in bringing together all of this testimony, which is of much importance to the electric light companies and cities of the country, but also for the introduction and epitome, which,

in a few pages, explain the points in controversy, the methods by which they were settled, the decision rendered, and the way adopted for arriving at a monetary value of the damage done. This case illustrates in a striking manner the advantage of arbitrating technical questions of this kind before engineers rather than carrying them to the courts. Every lighting company and every city in the country is more or less interested in the results of the investigation, which are discussed in detail in this book.

"Experimental Electrical Engineering." V. Karapetoff. New York. John Wiley & Sons. Cloth. 790 pages. Illustrated. 6 by 9 inches. Furnished by the ELECTRICAL REVIEW for $6.

Professor Karapetoff believes in what he terms the "concentric method of teaching." By this he means that the student should first be taken over the ground in an elementary way by means of a few simple experiments. He should then go over it again, making more elaborate experiments, and, if necessary, should again carry out work in all parts of the field. The present manual, however, while adapted to instruction of this kind, is not especially arranged for this method of teaching. It is suitable, however, for the concentric method, as the instructor may pick out and assign those experiments which he wishes the student to perform. The manual begins with a chapter on the measurement of resistance. In this the term is defined, the theories of the various methods of measurement are explained and the principles of the different types of instruments and the actual instruments themselves are described. This is followed by a chapter on the measurement of quantity and potential, the fundamental principles being discussed, the methods and apparatus described. Power measurements are next taken up; then the student is introduced to alternating-current phenomena. This section is followed by a study of magnetic properties. This ends the fundamental part of the book, the remainder being devoted to the study of electrical appliances and methods as used in practice. This includes all forms of lamps, transmission and distribution lines, generators and motors, both alternating and direct, transformers, polyphase apparatus, batteries, switchboards, electric railway apparatus, telephone and telegraphic instruments and special applications such as heating and welding. Under each experiment the factors to be investigated are enumerated, the method of conducting the work is explained, and what is required in the report is stated. A feature of the book which the reviewer would criticize is the amount of space given to the description of commercial apparatus. This apparatus is changing from day to day, so that to keep the work up to date will require frequent revision. Moreover, these descriptions can be obtained from trade catalogues, and were they eliminated, a considerable saving in space would be made. There has also been a rather liberal use of trade illustrations, which gives the book a somewhat cheap appearance, and in some cases the drawings are not what they should be. As a single illustration of this, the drawing of the dynamo given on page 333 shows a remarkable dynamo with an armature which certainly could not be revolved between the poles. This may seem a rather captious criticism, but neglect of such little details gives one an impression of carelessness which may not be justified.

"Standard Handbook for Electrical Engineers." New York. McGraw Publishing Company. Flexible leather. 1,284 pages. Illustrated. 4 by 7 inches. Furnished by the ELECTRICAL REVIEW for $4.

This handbook is unquestionably one of the best electrical books of the kind that has yet appeared. The strictly technical sections of the book have been prepared by experts in each field, while the work as a whole has been carefully edited and brought together in a manner making reference easy and quick. Among those contributing are Otis Allen Kenyon, who has prepared the chapters on general electrical properties and measurements, electromagnets, telegraphy and miscellaneous applications; Dr. A. S. McAllister, who has written the chapters on transformers and motors; H. M. Hobart and Mr. Kenyon, a chapter on electric generators; Edward Lyndon and Mr. Kenyon, that on storage batteries and primary cells; R. C. Beardsley and George Shaad, a chapter on central stations. Transmission and distribution are discussed by A. V. Abbott and Mr. Kenyon; illumination, by Dr. Louis Bell; electric traction, by A. H. Armstrong; electrochemistry, by Dr. E. F. Roeber, and telephones, by K. B. Miller. The character of the work may be inferred from the well-known writings of these various authors. Typographically the arrangement is excellent, as the careful use of bold-faced type enables the searcher quickly to place his finger on the particular information for which he is looking. Moreover, an excellent index with well-arranged cross-references makes the search for information easy. The publisher has also been careful in his selection of paper, and has bound the book handsomely, so that it will withstand the hard wear and tear for which it is intended. Those who are looking for a good, reliable electrical handbook can not do better than to purchase this one.

Exposition of Safety Devices.

Announcement has been made that an exposition of two months will be opened early in April in New York city, under the auspices of the American Museum of Safety Devices and Industrial Hygiene, for showing the best methods of safeguarding workmen and protecting the general public. The exposition will consist of safety devices, protected machinery in actual operation, models and photographs. During the exposition illustrated lectures by engineers will explain industrial conditions and hazardous occupations and the most approved methods of safety.

Believing that many accidents are preventable, and to stimulate further invention, three solid gold medals are offered for the best safety device in the fields of transportation, mining, motor vehicles and motor boats. Two prizes of $100 each, one for the best essay on "The Economic Waste Due to Accidents," and the other on "The Economic Waste Due to Occupational Diseases," are offered.

The chairman of the committee of direction is Charles Kirchhoff, and of the committee of exhibits, Professor F. R. Hutton.

There will be no charge for space. All inquiries and applications for space should be made to Dr. W. H. Tolman, at the Museum, 231 West Thirty-ninth street, New York city.

Electrical Supplies for the Navy Department.

The Bureau of Supplies and Accounts will open bids in Washington, D. C., on February 25 for the following electrical material: 42,870 duct-feed of six-duct multiple conduit and two twenty-horse-power motors, for delivery at Charleston, S. C.; 28,000 feet of steel-enameled conduit, for delivery at Boston, Mass.; two seven-and-one-half-horse-power motors with panel equipment, for delivery at Pensacola, Fla.; necessary parts to change gate-valves from hand-operated to automatically controlled, direct-connected, motor-driven valves, except wiring between switchboard and motors, for delivery at New York, N. Y.

THE CENTRAL POWER STATION AT THE PLANT OF WALTER BAKER & COMPANY, LIMITED.

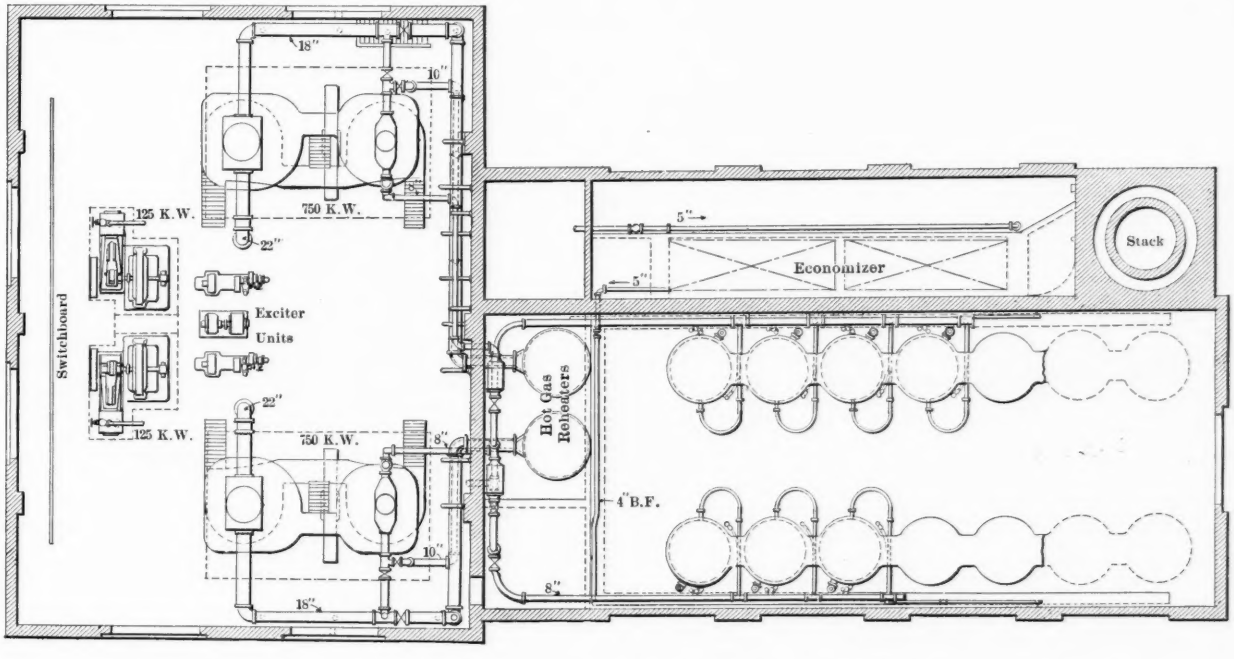
REHEATERS ARE USED WITH THE COMPOUND ENGINES, THREE-PHASE ALTERNATING CURRENT, AT 600 VOLTS, FOR POWER AND LIGHTING.

The establishment of Walter Baker & Company, Limited, at Dorchester, Mass., a suburb of Boston, embraces a number of mills engaged in the manufacture of chocolate and cocoa products. They are located at the crossing of Washington street and the Neponset River, about six miles from the centre of Boston, and embrace plants on opposite corners of the street and the stream, known as the Baker mill, the Webb mill, the Pierce mill and others. These mills are large plants in the consulting engineer and architect, has been located apart from the mills, so as not to interfere with future extensions and additions to the mills, and so that the latter may not, in any way, be dependent upon power considerations. It is situated on the northerly bank of the Neponset River up-stream from the mills, where the stream is several hundred feet in width and an ample supply of circulating water is available. The river water is of such a quality that it is used for feed for the boilers as well as for condensing. Convenient rail connections were also available at this point, for receipt of fuel and for handling machinery.

The plant is laid out on the cross-boiler-room principle, with a sixty by eighty-foot main engine room and a fifty-seven secured. In the latter room the roof planking is concealed by sheathing of matched North Carolina pine. For the handling of machinery a ten-ton hand-operated traveling crane of fifty-nine-foot span covers the engine room, traveling on twenty-inch I-beam runways, which are supported upon ornamental pilasters in the wall construction at frequent intervals.

The plant has been designed for an ultimate capacity of 2,800 horse-power in boilers and 1,750 kilowatts in electrical generating machinery.

The two large units are vertical cross-compound engines built by the Allis-Chalmers Company, which have twenty-two and forty-eight-inch cylinders with forty-eight-inch stroke. They are both direct



PLAN OF THE STEAM AND ELECTRICAL PLANT OF WALTER BAKER & COMPANY, LIMITED, DORCHESTER, MASS.

themselves, which have, until recently, been operated by independent steam plants. In each case the engines were pairs of horizontal simple condensing and non-condensing engines, supplied with steam by horizontal return tubular boilers, but it was some three years ago decided to have an economical central plant. For this purpose an extensive new power station has been built for the operation of all of the mills as a single unit, by means of which a maximum of economy and reliability might be attained.

The new power plant, of which the following description is furnished by the Allis-Chalmers Company, of Milwaukee, Wis., through the courtesy of F. W. Dean, by ninety-six-foot boiler house extending at right angles from one end. It is constructed of brick on concrete foundations throughout, and has a wooden roof supported on steel trusses. The architectural treatment of the exterior is simple, yet productive of pleasing results, a feature of which is the liberal provision of windows for interior lighting. The roofs are covered with tarred paper and gravel and are nearly flat, draining to the outside with inside gutters. The interior is finished with common red brick painted with cold-water paint in the boiler room, while in the engine room the finish is red pressed brick with limestone trimmings, by means of which an attractive interior has been connected to 750-kilowatt alternating-current Allis-Chalmers generators, which are mounted alongside of the fifteen-foot flywheels on the engine shafts. The smaller generating units consist of simple horizontal eighteen by twenty-six-inch engines, direct connected to Allis-Chalmers 125-kilowatt alternators. There are, in addition to the above, two steam-turbine-generator sets of fifty-kilowatt capacity each, which, together with a motor-generator set of equal capacity, are utilized for excitation purposes. The large engine units are supplied with steam by eight-inch connections from the boiler room main, while the small horizontal units have five-inch connections and the tur-

bines three-inch connections from the basement steam main. The larger units exhaust, as above stated, to the condensing units in the basement and the small engines to the low-pressure main in the basement. A noteworthy feature of the engine installation is the use of reheaters for the compound engines, which are supplied with heat by the hot gases passing from the boilers to the stack. These reheaters consist of large cylindrical receivers, each fitted with a large number of six-inch boiler tubes through which the hot gases are passed. They are located, as previously stated, on the concrete platform in the boiler room, elevated thirteen feet above the floor to facilitate connections to the flues and economizer. The smoke connections are led to both reheaters in multiple, while the steam connections are separate, one reheater serving for either engine. The latter connections consist of ten-inch lines from the exhaust side of the high-pressure cylinders, and eighteen-inch return lines from the reheaters to the admission side of the low-pressure cylinders, the steam being superheated about thirty degrees Fahrenheit in passing through the reheaters under ordinary conditions. The oiling of the compound engines is accomplished by gravity from an elevated tank, the oil after passing the engines flowing by gravity to a filter in the basement, from which it is returned to the elevated tank again by a small duplex pump.

The condensing equipment consists of two surface condensers, one serving for each of the compound-engine units, to which circulating water is supplied from the Neponset River by two electrically driven centrifugal pumps. The condensers have separate five and one-quarter by four and three-quarters by five-inch duplex condensation pumps located in a pit under the hot-wells, which deliver to the feed-water heater in the pump room. Each condenser is operated with a dry vacuum pump, which draws from the top of the condenser casing through four-inch lines and discharges through a common four-inch line ending in the circulation water overflow outlets. The six by eight-feet intake well is depressed in the basement floor at the southeast corner next the river, sixteen feet below the engine-room floor level, and has a connection to the river alongside by a thirty-six-inch cast-iron pipe extending through the building wall foundation at that side. This intake pipe is provided with a valve so that the water can be shut off and the well pumped out and cleaned, and the well also has two sets of removable copper screens on the inner end of the inlet pipe.

The generating machinery is now all in place, but owing to the present requirements of the mill, but a part of the steam generating capacity has been installed. The latter consists of vertical fire-tube boilers in 200-horse-power units, for which space has been provided in the boiler room for two rows of seven on either side, facing a central firing floor. Of these, five are installed on each side at the end of the boiler room nearest the engine room. Special features of the steam plant are the use of the vertical fire-tube boilers, hot-gas reheaters for reheating the intermediate stage steam from the compound engines and flue-gas economizers. The hot-gas reheaters are located on an elevated platform at the engine-room end of the boiler room, and the economizer in a seventeen by eighty-six-foot annex to the southerly side of the boiler room. The boiler room proper is forty by ninety-six feet in size and has a clear headroom of thirty-six feet under roof trusses, there being no basement, although there is, under the elevated platform carrying the hot-gas reheaters, a thirteen by forty-two-foot space with twelve and a half feet clear headroom in which are located the boiler feed pumps and heater. The main engine room, which is sixty by eighty feet in size, has a headroom under the roof trusses of forty feet to provide for vertical engines and the traveling crane above, and a basement with ten feet minimum headroom, accommodating condensing equipment and piping.

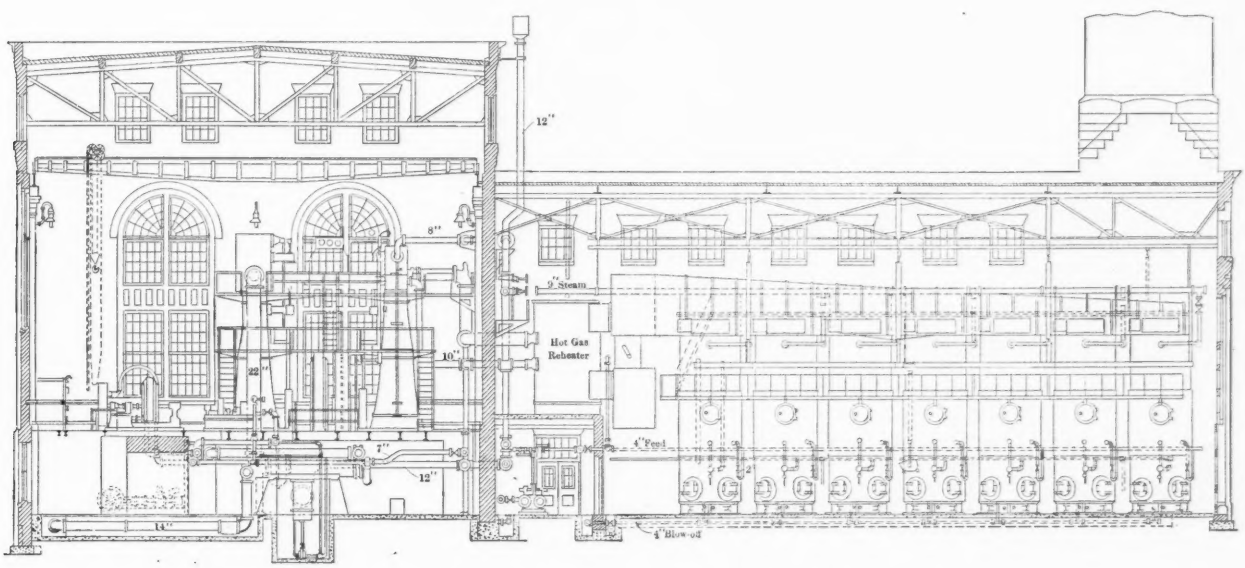
The boilers have eight-foot shells standing twenty-six and a half feet above the floor and have 308 two and one-quarter-inch tubes fifteen feet long, which present an effective water-heating surface of 2,000 square feet. They are internally fired, having grates seven feet four inches in diameter, with combustion spaces six feet above the grate level. They are arranged for hand firing, coal being wheeled into the boiler room, which, together with the handling of ashes, is greatly facilitated by the use of a central firing floor with rows of boilers on either side. The products of combustion are removed by a 200-foot brick stack of eight-foot interior diameter, which is located at the rear corner of the boiler house and is connected to the boiler smoke boxes by an overhead flue. The flue is of one-eighth-inch steel, suspended from the steel roof trusses, and ranges in size from six by four feet at one end of the boiler room to six by eight feet at the other, where connection is made to the hot-gas reheater and thence to an economizer in the side addition to the boiler house, which extends back to the stack at the rear end. The connections from the flue to the boilers are twenty-by-sixty-inch ducts which connect with the side of the smoke boxes so that the entire top of the latter is left free for removal for access to the boiler tubes. From the large end of the flue two forty-by-eighty-inch connections are taken to the tops of the hot-gas reheaters, from the bottom of which ducts of similar cross-section lead across into the annex building, to connect with the economizer. Both of the reheaters have forty-by-eighty-inch dampered by-passes and the economizer has a by-pass eight feet square formed under the concrete platform on which it is supported.

The boiler-feeding equipment consists of two duplex outside-end-packed feed-pumps, a Cochrane feed-water heater and purifier and a Sturtevant economizer, all of which have been installed of sufficient capacity to provide for the total projected boiler plant of fourteen boilers. The pump and the heater are located in the space underneath the elevated platform carrying the hot-gas reheaters, and the economizer in the side addition to the boiler room, in which it is mounted on a concrete platform eight feet above the floor level and is forty-four feet in length. The feed-pump suction connections are so arranged that the pumps will ordinarily draw through six-inch suctions from the feed-water heater into which the condensation from the surface condensers is delivered by condensation pumps in the engine-room basement. Make-up water is added from the city water system, from the circulating water or from the pond directly. The feed-heater is supplied with steam from the exhaust delivery line from the small generating units and auxiliary steam-using machinery in the plant, to which it is connected inductively, low-pressure steam being used in large quantities in the various mills for manufacturing purposes. The atmospheric relief connection from this low-pressure line is made through the feed-heater, a six-inch relief line with two Schutte back-pressure valves connected in multiple, being extended from the top to the twelve-inch atmospheric exhaust riser, which serves the main engines of the plant. Watts reducing valves admit live steam to the low-pressure system as needed to maintain the pressure. The feed-pumps deliver through a five-inch line which extends to the economizer, with, of course, a by-pass connection direct to the boilers. The latter is

a ring main of four-inch brass pipe, which is laid out to encircle the boiler room, although at present it has been extended only so far as the boiler units now in place. The boiler branches are two-inch brass connections which are brought from the main at the rear around to the front of the shells, through which the connection is made at a point about two feet above the crown sheet, through two valves and a check-valve, permitting access to the latter while the boiler is in service. A feature of the water connections to the boilers is a cold-water main paralleling the ring feed main, from which a connection is made to each boiler for purposes of washing out and for filling up after washing, consisting of a two-inch branch with stop and check-valves; it is supplied directly from the city water main. Feed-pumps have an emergency delivery connection to this main to permit feeding to the boilers in this way if anything should happen to the regular feed-main. The boiler blow-off system consists of a four-inch cast-iron blow-off main located in a trench at the rear of either row of boilers, which connect with a cross line of similar size at the forward end of the room, leading to discharge into the river alongside. The boilers have two and one-half-inch blow-off connections into the main, each consisting of two Morris blow-off valves connected in series. The economizer has a four-inch blow-off connection which delivers into this line at a point near the side of the building, while the feed-water heater has an independent four-inch blow-off line, which is carried in the same trench to the point of discharge.

The high-pressure steam-piping system consists of an eight-inch ring main in the boiler room, with four-inch supply connections from each boiler, and has delivery connections to the main engines in the engine room, to the auxiliary machinery in the basement and to high-pressure delivery lines to the mills. The ring main is supported by hangers from the roof trusses at a level considerably above the tops of the boilers, the boiler branches consisting of double long-radius bends from the steam nozzles at the front of the shell around the sides to the rear and up to the main. The two large vertical engines are supplied independently by eight-inch connections, which are carried up at the division wall end of the boiler room to thirty by forty-two-inch receiver separators, extending thence through the walls to the throttle valves. For the supply of the small horizontal engines, the auxiliary machinery and the high-pressure lines to the mills, a ten-inch line extends down into the engine-room basement, from which an eight-inch branch extends to the mills and a seven-inch line to the auxiliary machinery and the horizontal engines. From the latter line steam is supplied also to the auxiliary equipments, including the dry-air pumps of the condensing equipment, the condensation pumps and the boiler-feed pumps.

The exhaust piping of the plant is simple. For the large engines there are direct twenty-two-inch connections from the low-pressure cylinders through the floor to independent surface condenser units in the basement, in each of which connections there is an automatic relief valve, delivering to twelve-inch lines to a common atmospheric riser and exhaust head above the boiler-room roof. In each of the twenty-two-inch exhaust connections from the engines there is inserted close to the condenser a twenty-four-inch Cochrane oil separator, for the purpose of freeing the exhaust steam from lubricating oil entrained from the engine cylinders and thus preventing contamination of the boiler feed. The auxiliary exhaust system starts in an eight-inch connection to the intermediate stages of the large vertical compound engine units at points where the exhaust from the high-pressure cylinders enters the hot-gas reheaters. From here the line drops into the pump room, where it is joined by the three-inch exhaust from the feed pumps, and enters the Cochrane open feed-water heater through an oil separator. The line then extends into the engine room basement, where it is joined by an eight-inch main serving the horizontal generator engines, the exciter engines and the condensation pumps, and continues as an eight-inch line to the mill buildings for the low-pressure steam supply. There is a reserve connection to this low-pressure main from the live steam header in the engine room basement, consisting of a four-inch Watts reducing valve with by-pass, thus permitting live steam to be added in case of deficiency of the exhaust. The low-pressure supply will ordinarily be furnished by the small engine units and the auxiliaries, the connections to the intermediate stages of the compound engines being for the purpose of adding to this supply without the use of live steam and still without sacri-



LONGITUDINAL SECTION OF PLANT OF WALTER BAKER & COMPANY, LIMITED, DORCHESTER, MASS.

ficing the advantages of operating the large engines condensing.

The Allis-Chalmers generators deliver three-phase, alternating current at a potential of 600 volts, at which voltage current is transmitted directly to the mills for power and lighting purposes. The power feeders and the machines are controlled from a blue Vermont marble switchboard sixty feet in length, which contains panels for the generators and feeders, and totalizing instrument panels. All circuits to the different mills have recording meters for measurement of the power supply to each department separately. The mills are operated entirely by induction motors, of which there are about 100 installed, ranging from one to seventy-five horse-power and arranged for both individual and group driving. The lighting is done on the two-wire system at 110 volts, the voltage being reduced from the power feeder lines by transformers at each mill. The power feeders are carried to the mills through a steel bridge to the Baker mill, from which they pass over a bridge across the river to the Webb mill and through a subway some 200 feet in length under Washington street to the Pierce and other mills.

This power plant and the new power and lighting equipment of the various mills was designed and the construction superintended by F. W. Dean, mill engineer and architect, of Boston, Mass., formerly of the firm of Dean & Main.

The principal data concerning this plant may be summarized as follows:

Plant laid out on cross-boiler-room principle.

Main engine room, sixty feet by eighty feet; boiler house, extending at right angle to engine room, fifty-seven feet by ninety-six feet.

Foundation, brick and concrete, with wooden roof, suspended upon steel trusses.

Ten-ton, hand-operated, traveling crane.

Ultimate capacity, 1,750 kilowatts in electrical generators; 2,800 horse-power in boilers.

Three duplex pumps; one feed-water heater and purifier; one economizer.

Two surface condensers, with dry vacuum pumps.

Two electrically driven centrifugal pumps.

Switchboard, sixty feet long, of blue Vermont marble.

Motor installation includes 100 induction motors, of one to seventy-five horse-power.

Reducing the Hazard of Moving-Picture Machines in New York City.

On Christmas Day last year a serious fire occurred in New York city in a building where a moving-picture machine was in operation, the flames spreading with such rapidity that the sixty persons present barely escaped with their lives. Upon investigation it was discovered that the moving-picture machine had been operated by a boy who was entirely incompetent and too young to understand the dangers of his position; and in establishing the responsibility for the fire the blame was placed entirely upon the film being set on fire by the arc lamp used with the moving-picture machine.

Having the responsibility thus put so plainly up to the Department of Water Supply, Gas and Electricity, this department determined to leave nothing undone to render impossible a repetition of this condition, and supplementing the strenuous efforts which had already been made, and which have been quoted in these columns, it was determined to make a special study of the conditions under which these moving-picture machines are operated and to put into operation whatever restrictions would seem to be necessary. First of all, every license which had been issued to operators or managers of moving-picture machines or places of amusement where these machines were operated was looked up, and the proprietor or manager was called into the offices of the department and put under a rigorous examination. It was discovered that of the 180 places where these moving-picture machines were operated, over ninety-five per cent were kept by foreigners and incompetent people, seventy-five per cent of this ninety-five per cent being apparently unable to read and comprehend the printed instructions which were issued at the time of issuing their licenses. In every case where it was discovered that the operator or manager could not read the instructions the license was taken away. It was a great surprise to the officials to discover how quickly these foreigners learned to read the instruction sheets. In many cases men who professed to be entirely ignorant of the language came back within a week able to understand all of the instructions which were given to them in printed form.

It was discovered, also, that boys were being allowed to operate these machines, and it was decided to withhold all licenses from those who could not carry on an intelligent conversation with the inspectors of the various departments and who could not read the printed instructions issued for their guidance.

The department has also undertaken to register the names and addresses of all operators of moving-picture machines, giving them a number, and making a record of their years of service and their ability to operate these machines. In addition to this the operators are placed in the department's laboratories, in which there has been fitted up a moving-picture machine in the condition in which such machines are usually found in operation in the various places throughout the city. The operator is then told to go ahead and discover all the faults he can, which usually consist of paper and films being exposed and littered about the booth, places where smoke and flames could find exit from the booth, imperfect shutters intended to cut off the beam from the arc light upon a film which might be standing still and thus cause a fire, exposed connections, changes in the rheostats and similar conditions which would create a hazard. If the operator can not discover the obvious dangers and apply the proper remedies, or ask for proper assistance, the license is not given out.

The department has also called into consultation the manufacturers of these machines, and has secured the co-operation of these manufacturers to the extent that when the machines are delivered they are as safe as can be reasonably expected, and, at the same time, operate satisfactorily.

Each machine is numbered permanently, this number corresponding to the certificate issued for its operation. If a man were discovered operating a substitute machine or violating any of the regulations which the department has laid down, his license would be revoked, and under no condition whatsoever could this person secure a license again to operate a moving-picture machine in New York city.

If these plans are found not to prove effective, then the department will undoubtedly rearrange entirely the conditions governing the location of moving-picture exhibits. It is possible that it will not issue any more permits to have moving-picture entertainments in buildings located in the centre of a block. These exhibits may be confined to corner stores where there are side exits and ample front exits; or, again, it is possible that where these exhibits are given the condition may be laid down that the entire moving-picture apparatus shall be constructed and contained within a metal-lined cabinet situated behind the screen,

which will take the form of a ground-glass plate, the whole to be entirely surrounded by metal, the entire front of the place where the exhibit is held being capable of being thrown open into one wide doorway. In other words, if the restrictions which have been determined upon do not eliminate the danger to life by reason of fire and smoke, no more permits will be issued which will allow the moving-picture machine to be between the audience and the latter's place of exit. If these further restrictions do not eliminate the danger to life and property, the moving-picture exhibits will be closed up altogether.

Public Service Commission Takes Up Meter Testing with Electric Companies.

Commissioner M. R. Maltbie, public service commissioner of the First District, State of New York, has called upon the seventeen electrical companies doing business in Greater New York to make reports to him not later than February 17 of the manner in which electric meters are tested by each company and the types and total number of meters now in use. A blank form has been prepared and copies sent to each company, so as to insure uniformity in the reports. In this form the companies are directed to answer the following questions:

"Are periodic tests made of meters already installed? If so, how often? What do the results of such tests show? Are meters tested on customers' premises usually readjusted on the spot or removed and new meters installed? What is the system for testing meters on complaint and what apparatus is used? What percentage of meters tested on complaint is found fast and what percentage slow? Also what percentage is found within the requirements of the law, namely, less than four per cent fast?

"Do you use one man or two working together to make tests on customers' premises? If one man, how many meters can he test in a day? If two men, how many meters can they test in a day? Are the repairs and necessary adjustments made by these men at the time of the test? What is the length of your working day? What method is used for testing new meters? What portable test meters or other testing apparatus is used? How often and where is the apparatus calibrated? What station standards are used?"

Blank statements are also provided for the companies to fill in showing the number of meters in use, the different makes and their capacity.

Important Decision in the Kellogg Switchboard and Supply Company Shares Suit.

Judge Winds, in the Cook County (Ill.) Circuit Court, on Saturday, February 1, rendered a decision of importance to the telephone industries of the country. By virtue of the court's decision the American Telephone and Telegraph Company is directed to return to the original owners 4,311 shares of stock in the Kellogg Switchboard and Supply Company, of Chicago, Ill. The court is of the opinion that the holding of the Kellogg stock by the American Telephone and Telegraph Company was contrary to law, and that it tended to create a monopoly.

The Kellogg Switchboard and Supply Company was organized in 1902 by Milo G. Kellogg. Mr. Kellogg later went to California because of ill-health, leaving a power of attorney with Wallace DeWolf. The latter, the court record declares, transferred all of the Kellogg stock to the American Telephone and Telegraph Company, and as the company made a specialty of manufacturing for independent companies, the effect of the trade on the transfer of the stock was of considerable importance. Kellogg later brought suit to have the transfer set aside, and minority stockholders joined in the suit, alleging that it was against the public policy to allow one corporation to hold stock in a competing company. It was also alleged that the transfer of the stock constituted a violation of the Sherman Anti-Trust law.

Rubber Production in Paraguay.

The United States Consul Edward J. Norton, of Asuncion, Paraguay, has submitted a report dealing with the rubber production of that country. He states that during the last year about 4,500 pounds of rubber were exported, mainly to France. There are three principal rubber-producing trees: One, the *mangá icé*, is abundant in the northern sections; it grows wild, in open spots. The trees are ready for tapping in five years, and the large trees yield about four pounds of rubber a year. As they are rather scattered, the cost of production is high. The quality of rubber is not of the best, but this may be due to the method of preparation. The second class of rubber-producing trees is of the *mandioca* species. It is a tree of rapid growth. The rubber is said to be superior to that of the *mangá icé*, and the sap coagulates on exposure to the air. The trees grow to a height of forty feet, yielding from ten to twelve pounds from the large trees. The third class of rubber-producing plants are the vines, but no reliable information concerning the production of rubber from these is available.

Demonstration Apparatus for Illustrating Commutation.

A description is given in the January 17 issue of the London *Electrician* of two devices designed to illustrate the effects of commutation. One of these shows the effects of varying the brush width and position, of varying the inductance of the armature coils and of varying the commutating electromotive force. It consists of a wooden disc, on which are fastened two brass strips forming an ordinary two-part commutator. Slip rings mounted on the same shaft place in series between the two contacts a coil wound upon an iron core and arranged so that its inductance may be varied. In series with this coil is another two-part commutator with slip rings, by means of which a varying electromotive force supplied from a storage battery may be connected across the terminals of the coil. The second commutator is set at right angles to the first. The whole apparatus is connected across a circuit so that current may be passed through it. When this is done the current through the coil will be reversed twice every revolution. By means of the apparatus the effect of varying the brush resistance is shown. It can also be shown that, when the reversing electromotive force supplied by the battery is not sufficient, no width of brush will prevent sparking; that the reversing electromotive force must be varied when the external load varies or when the frequency of reversal varies; and that when the reversing electromotive force is too great, no arrangement of brushes will prevent sparking. The second device is intended to show the effect of the brush resistance in producing sparkless commutation. It consists of four brass plates connected in series through three ammeters and arranged so that the current from each end plate passes through a separate set of lamps. Current is supplied to the plates through a broad carbon brush as long as one of the plates. As this brush is slipped along from one plate to another, the current is transferred from plate to plate, and, by means of ammeters, the changes taking place in the different connections may be watched. This shows clearly how the current is gradually transferred from one plate to the next as the contact of the first decreases and that of the second increases.

REVIEWS OF CURRENT ENGINEERING AND SCIENTIFIC LITERATURE

Application of a Longitudinal Magnetic Field to X-Ray Tubes.

Some time ago Dr. John Trowbridge suggested that a longitudinal magnetic field might prove useful for concentrating the cathode rays in an X-ray tube. Since then he has experimented in this field and devised a means for securing this effect. The tube has a prolonged neck, around which is placed a solenoid movable along the neck. An iron disc anode with a perforation at its middle is used, the rays passing through, impinging upon the focus plane of polished platinum. These rays may be focused sharply on this plane by adjusting the field of the solenoid. When this is done the intensity of the X-ray is increased in a marked manner, seeming to be more than double that before the field is applied. This method also produces rays from a sharp focus and should, therefore, give better definition. While possibly rays of the same intensity might be secured if the energy employed in exciting the magnetic field were added to that which excites a tube, this would throw an increased strain on the tube and would not give the sharp focus produced by the magnetic field. Moreover, the application of the magnetic field serves as a rectifier, and when a Leyden jar is used it allows only the oscillations from the cathode to reach the focus plane.—*Abstracted from the American Journal of Science (New Haven), February.*

Effect of Chilling Aluminum.

It has been found by F. G. A. Wilm, of Drewitz, Germany, that the strength and ductility of aluminum may be increased if heated and chilled in a certain manner. Aluminum, like steel, has a critical temperature called the point of recalescence, which is made manifest by an emanation of heat. The temperature to which the metal, or its alloy—for the method is applicable to certain aluminum alloys—should be heated is found to lie between a point not more than thirty degrees centigrade below the point of recalescence and the point of solidification. The metal should be raised to a temperature somewhat above this, allowed to cool, and immediately chilled when it reaches this point. In illustration of this process, an alloy containing ninety-six per cent of aluminum and four per cent of copper solidifies at 640 degrees. The point of recalescence is 525 degrees. Deducting thirty degrees from the latter gives 495 degrees, above which temperature the chilling must take place. This was actually tried with a chilled casting of the alloy mentioned. The result was an increase in tensile strength of forty-eight per cent and an increase in elongation of two per cent. Nearly the same results were obtained with castings in sand, wire, sheet and rods. It has been found that the temperature of recalescence rises with the increase of copper content, being 485 degrees with one per cent of copper, and 540 degrees with thirty per cent of copper. The rate of increase in the temperature of recalescence is less with higher percentages of copper.—*Abstracted from the Engineering Times (London), January 2.*

The Nature of γ and X-Rays.

A reply is made here by W. H. Bragg to a criticism made by Mr. Barkla of the former's hypothesis that the γ and X-rays consist mainly of neutral pairs. Mr. Barkla has made some experiments bearing on this suggestion, in which he measured the amount of scattering of X-rays in different directions, and he found that his experiments are more in accord with the ether-pulse theory than the one mentioned above. Mr. Bragg has again returned to the matter and here describes some experiments which he believes are in agreement with his first statement. He has been comparing the secondary radiations issuing from the two sides of a plate through which γ-rays are passing. According to the ether-pulse theory, the radiations from the two sides of the plate should show complete symmetry, provided the rays have not been appreciably absorbed on the way through. Secondary radiations, whether material or not, originated in an atom by a passing pulse are just as likely to go backward as forward. On the other hand, if the γ-rays are material, it is possible that the secondary radiations on the two sides of the plate should be different. The author has found that there is a remarkable want of symmetry, and he believes that this is fatal to the ether-pulse theory. His experiments have also shown that the cathode radiations from a given stratum of matter transversed by γ-rays possess momentum in the original direction of the motion of the rays, and this shows the rays are material. The experiment consisted in passing a pencil of γ-rays along the axis of a cylindrical ionization chamber. These rays first pass through a centimetre of lead and then through a pair of plates which can be inverted. Such a pair may be made of a lead plate one millimetre thick and a carbon plate one centimetre thick. These form one end of the chamber. It will then be found that there is more current through the chamber when the carbon plate is next to it and the emergent secondary rays are produced in the carbon, than when the lead plate is next the chamber. The reverse condition is found when the plates are placed at the other end of the chamber, in this case the incident secondary rays being greater than the other. The differences are large, of the order from ten to sixty per cent, depending upon the experiment. From these results the author concludes that the γ-rays are material, as are also certain X-rays.—*Abstracted from Nature (London), January 23.*

The Electrical Equipment of a Modern Engineering Works.

A somewhat detailed description is given here of the electrical equipment of the iron works of J. E. Hall & Company, Dartford, England, which have recently been converted from steam and gas power to electric driving. The change was carried out entirely by the company's own force, and was accomplished without interfering in any way with the operation of the works. In the boiler room of the generating station there are two Lancashire boilers provided with superheaters. The feed-water is passed through a softening plant and the condensed water through an oil separator and economizer. In the engine room there are two three-cylinder, compound, high-speed engines, each rated at 350 horse-power at 300 revolutions a minute, each direct-connected to a compound-wound generator, rated at 250 kilowatts, direct-coupled to a motor which obtains its power from the Dartford sup-

ply system. This is used mostly for night work when the generating plant is shut down. In addition, there is a twenty-one-kilowatt motor-generator set used for the same purposes when the load is light. Both of these sets are arranged so that when necessary they can deliver power to the city supply system. As a good deal of current is required for welding purposes, three motor-generator sets provide for this. One of these is a fifty-kilowatt motor-generator set, the generator delivering single-phase current at 350 volts, fifty cycles. A heavy flywheel is attached to this unit to equalize the load on the power station. The other two motor-generator sets are each rated at thirty-five kilowatts and arranged to run in parallel, when necessary, with the fifty-two-kilowatt generator for furnishing the current for large welding operations. An elaborate switchboard and distributing system have been provided for securing great flexibility of control of the equipment. All of the wiring is colored to distinguish between the different leads—the positive direct-current wires being enameled red, the negative wires black, while the alternating-current wires are blue and white. This arrangement makes the tracing out of the circuits simple and facilitates work on the wiring. There are 130 motors used throughout the plant, many of them for individual driving and some of them for group driving.—*Abstracted from Electrical Engineering (London), February* 23.

Wireless Telegraphic Work in the French Navy.

Some striking results of the work done by the French Navy in developing a suitable system of wireless telegraphy for use on the vessels of war are described here. The French Navy has been at work in this field ever since the practicability of wireless communication was demonstrated, but in 1906 the government established a special commission for studying this branch of the service. The instruments now in use on the French vessels have been made at the French telegraph factory, with the exception of the generators and transformers, which have been purchased from private companies. Four recent installations on men-of-war have been made which have accomplished the remarkable records referred to above. Each equipment consists of a motor-generator rated at about five horse-power. Usually indirect excitation of antennæ is employed, while the systems have been arranged so that any of the known detectors may be used. Until these installations were made the maximum distance of transmission which had been covered was about 200 miles. By means of these equipments, however, the distance has been increased to nearly 500 miles in regular service, while occasionally messages have been transmitted over distances of about 850 miles, one-half of which was across land. An interesting result of these experiments has been the ease with which communication has been maintained at the station on the Eiffel Tower. The wave-length of this station is about 1,700 yards, while that of the men-of-war is 600 yards only, being about one-third of the other. Thus the third harmonic of the Eiffel Tower radiations alone is effective in sending the signals. Much progress has also been made in tuning the various equipments. Two of the men-of-war were sent ahead side by side for about 300 miles from two other vessels, which were separated by about thirty miles. With this arrangement it was found that either of the two vessels in the lead could communicate with either of those in the rear without any disturbance from the other. No interference whatever took place. It is thought that one reason for the great success of these equipments lies in the small size of the apparatus which, on this account, exerts but little damping effect on the radiations.—*Translated and abstracted from L'Eclairage Electrique (Paris), January* 18.

Water for Economical Steam Generation.

The effect of the quality of the water employed for producing steam in central stations upon their economical operation is discussed here at some length by J. C. William Greth. Rain water or melted snow are the purest natural supplies, following which are the waters of creeks, rivers and lakes. Well water is not so good. Very few natural supplies of water may be fed into a boiler without loss from the following causes: Waste of fuel due to scale, reducing the efficiency of the boiler; loss due to labor required for cleaning heaters, piping and boilers; extra investment in boilers to make up for those out of service; cost of boiler compounds; increased repairs due to the effect of the scale; loss of heat when cooling a boiler for cleaning; reduced efficiency of heaters and economizers; loss due to cost of city water over pumping and softening an available supply; cost of cleaning machines and loss of efficiency of earning power of improved furnaces. The formation of scale in a boiler is due to two causes. At the increased temperature the water loses its power of holding in solution scale-forming substances, and evaporation of pure water concentrates the impurities of the water in the boiler until it becomes supersaturated. Exhaust and live-steam heaters are now used for precipitating these scale-forming substances in the heater, but these devices only partially accomplish their removal. The use of a heater as a purifier interferes with its proper performance as a heater, rendering it less efficient. Surface condensers are frequently used to return the condensed water to the boilers, thus maintaining a soft supply, but this arrangement introduces the objection that oil is contained in the feed-water, and may damage the boiler, as it interferes with the efficiency of the condenser. The ideal method of purifying boiler feed-water is that which brings about the removal of the scale-forming and corroding substances by chemical treatment. There are two distinct types of such systems, the intermittent and the continuous, either of which, when properly designed and operated, gives a soft, clear boiler feed-water. For the best results the following are the requirements, which are all met by the intermittent system, and approximately all by the continuous system. The chemical treatment should be accurate, the agents thoroughly mixed with the water, the chemical reaction should be accelerated by thorough mixing and by heating the water if necessary, the reaction should be complete, the sedimentation should be rapid, and is brought about generally by stirring up the sludge in the water, and clarification should be perfect, which requires sufficient time for sedimentation. The author then gives some figures showing the effect of purifying the water for two power plants, each containing four 125-horse-power boilers. One plant employed city water, which was good; the second plant first depended upon well water and later added a softening plant. The expense involved in the use of well water is about ten per cent less than that for the city water, but after the softening apparatus had been added, the expense for water in the second station was about forty per cent less than that at the station using city water. Statistics of the coal consumption at the second station before and after installing the water-softening plant show a saving of about twenty per cent of the fuel due to this apparatus.—*Abstracted from the Engineering Magazine (New York), February.*

INDUSTRIAL SECTION

ILLUSTRATED DESCRIPTIONS OF NEW AND STANDARD ELECTRICAL AND MECHANICAL APPARATUS

The Westinghouse Post-Brake Type SP for Rolling-Mill Service.

The latest addition to the Westinghouse Electric and Manufacturing Company's list of apparatus for rolling-mills is an improved brake, specially designed to meet the severe requirements of motor work in iron and steel-mill service. It is of the solenoid post type, designed as Westinghouse post-brake type SP.

It is simple in construction, liberal in design and effective in operation. Its principal members are a brake-wheel and two friction shoes, which are mounted within a structural frame supported by a steel base, being controlled by a heavy steel spring and a solenoid in a cast-steel frame, which completely encloses the coil. The brake is built entirely of cast iron and steel. Cast iron is used in the wheel and shoes, where its better wearing qualities and cheapness of renewal make it preferable. The shoes and wheel are operated perfectly dry, and cast iron is found also to be the best for metallic surfaces unlubricated. The wear on the wheel is about one-sixteenth of that of the shoe. The maintenance cost is low, and all repair parts are easily made in any repair shop. The open construction permits easy inspection of all parts.

The shoes are clamped to the wheel during the brake period by means of a steel spring, and are released by the solenoid. The full force of the brake is applied at the moment of contact between the shoes and the wheel, and as soon as contact is made the spring ceases to contract; therefore the braking force never gets beyond its normal value and the stress on the brake parts and motor shaft is much less than in the case with ordinary brakes.

There is practically nothing in connection with the brake to get out of order, and the only attention needed is an occasional adjustment to take up the play due to the iron of the shoes. All parts needing adjustment are easily accessible. No lubrication of either shoes or wheel is required.

In the design of the brake special attention has been paid to heating tendencies, and ample provision made to counteract their effect. The rim of the wheel is corrugated on the under side for the double purpose of increasing its strength and giving the maximum radiating surface.

The arms are numerous and curved to permit an expansion of the rim due to heating, without producing undue stresses

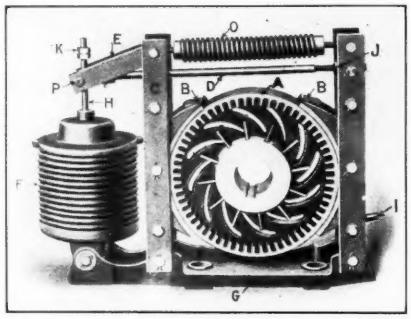


FIG. 1.—FRONT VIEW OF WESTINGHOUSE TYPE SP BRAKE.

A—Wheel. B—Shoe. C—Beam. D—Compression member. E—Tension member. F—Casing-enclosed solenoid. G—Motor frame supporting the brake. H—Connecting rod. I—Screw for adjusting clearance. J—Screw to take up wear of shoe. K—Nut for adjusting travel to beam. O—Pressure Spring. P—Fulcrum of lever.

in the arm or rim. On each side of the arms and extending from the hub are vanes, which produce a current of air directed against the corrugations inside the rim while the wheel is running. This increases the radiation of heat generated and keeps the heat away from the motor bearing.

The shoes are of cast iron with a solid thick face to permit long wear. On the

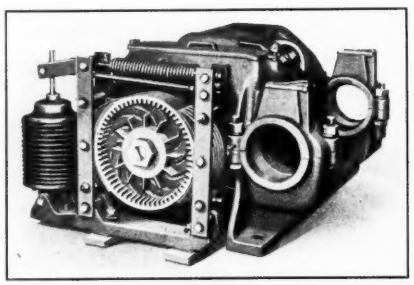


FIG. 2.—WESTINGHOUSE TYPE SP BRAKE.

rear of the shoe is a series of narrow ribs, which strengthen it and increase the radiating surface.

In operation the shoe is free to turn on a pivot and find a true seat on the wheel. The pressure against the wheel is thus uniformly distributed and unusual wear in any one part of the shoe is prevented.

The magnet is of cast steel, the frame completely enclosing the coil. It is pivoted at the base, which prevents any tendency to bind as it follows the wear of the shoe.

The coil may be either series or shunt wound for a direct-current circuit of 110, 220 or 500 volts. The series winding is preferable to the shunt due to its quicker action, and is considered as standard. The series coils will release the brake at 0.6 of the full-load current of the motor, and will hold it open at 0.1 full-load current.

The brake is secured to the motor by means of suitable brackets, which may be made integral with the motor frame when so specified. This arrangement is strongly recommended, as it precludes all possibility of the brake ever getting out of alignment.

These brakes are at present made in five sizes for twenty-five, fifty, seventy-five, 100 and 150-horse-power motors, and may be applied to any type of motor used in mill or crane service.

Pennsylvania Railroad Places 1908 Rail Order.

Definite orders for steel rails have been placed by the Pennsylvania Railroad with steel manufacturers for 55,000 tons, to be delivered during 1908. These, in addition to 30,000 tons left over from 1907, will give the company 85,000 tons for use this year.

These rails will be rolled under entirely new specifications. In view of the increasing severity of road service and the recognized necessity for developing an improved steel rail, the Pennsylvania Railroad has for some months been conducting an exhaustive examination of the entire art and practice of rail manufacture. A committee of experts—representing not only the railroad but two of the important steel manufacturers—was appointed by the Pennsylvania system last summer to make a special study of the subject.

The series of experiments undertaken were probably unprecedented in their completeness and in the importance of the scientific data which they supplied. The rail sections are believed to be a distinct

improvement upon those hitherto in use on the Pennsylvania system.

Most important of the features of the new specifications is the placing more upon the manufacturer the responsibility for the character of the rail produced. The company recognizes that it is merely a purchaser—not a manufacturer. Considerable latitude is, therefore, to be allowed in the methods of manufacture utilized so long as the result is a sound rail. The company has devised tests of a character so exacting that it is made very much to the interest of the manufacturers to discard all material of the soundness of which there is any doubt.

No specification, for example, is made as to the amount which shall be sheared from the end of the bloom formed from the top of the ingot. The problem of a proper discard has been discussed very freely by the different societies which have been considering rail specifications. Various percentages have been proposed—a discard of twenty-five per cent having the greatest number of advocates. The Pennsylvania Railroad feels, however, that in the present state of the art, at any rate, the responsibility for a proper discard should be left with the manufacturer.

The new specifications also provide that rails shall be free from "injurious" mechanical defects and flaws. This differs from the old specifications in that no attempt has been made to describe the particular defects or flaws that will cause the rejection of rails. It is not considered wise to attempt to classify in the specifications the relative importance of defects, but it is specified that no rails will be accepted that contain defects or flaws which in any way impair their strength.

In connection with this order the agreement arrived at by the various steel-rail manufacturers is interesting. E. H. Gary, of the United States Steel Corporation, is quoted on this subject as follows:

"An agreement has been reached by the steel rail manufacturers and many of the railroads regarding a new form of rail, and the specifications agreed upon provide for a heavier rail with an improved section. The additional cost, if any, is to be borne by the purchaser."

Fire in the Trenton (N. J.) Plant of the Roebling Company.

One of the wire-rope shops of the John A. Roebling's Sons Company, at Trenton, N. J., was destroyed by fire on February 5, involving a loss of about $200,000. The shop will be immediately rebuilt and no difficulty is expected to meet the present demand for wire rope, or through additional facilities to meet the increased demand which will naturally come on within a short time.

The Electric Drive in a Hardware Factory.

The popularity of the electric motor drive is due in no small part to the general satisfaction that has attended the use of squirrel-cage induction motors. Simple and rugged in construction, reliable and efficient in operation, they are remarkably free from the operating difficulties that attend the use of the more sensitive commutator motor. Manufacturers, realizing these as well as the further advantages pertaining to the use of the electric-motor drive as a whole, now specify electric motors for power purposes when contemplating the erection of a new plant or the enlargement of the old.

A notable example of the application of the induction motor drive to the solving of power problems in a modern manufacturing establishment is found in the factory of the O. M. Edwards Company, of Syracuse, N. Y. This company is an extensive manufacturer of hardware specialties used in both the steam and electric railroad trade, such as window and extension platform trap-door fixtures, steel window sash, moulding, etc. Formerly the company purchased power from the Syracuse Lighting Company, using 500-volt, direct-current motors for driving the wood and metal-working machinery. The company was so well satisfied with electric-motor drive that when the factory was enlarged an isolated alternating-current plant was installed, together with a complete induction-motor equipment.

The generating equipment consists of a Sweet straight-line engine direct connected to a 220-volt, seventy-kilowatt, sixty-cycle, three-phase generator. The generator is of the revolving-field type built by the General Electric Company. A tap is brought out from the neutral point of the generator winding for incandescent-lighting purposes.

The motors are of the standard General Electric squirrel-cage type, the total capacity installed being a little over 100 horse-power. The method of drive is what is commonly known as the group drive, the motors being suspended on platforms from the ceiling. In each machine room the machines are assembled in four groups, a motor in each corner of the room driving separate line shafting, from which machines are belt driven. Starting compensators are placed conveniently near to the motors.

This model factory is modern in every respect. Special attention has been given to the arrangement of machines, with the result that a minimum of time is lost between the different stages in the manufacture of the product. The wiring is all conduit work and adds considerably to the finished appearance of the interior.

The entire electrical equipment has been in operation continuously eleven hours per day for over a year without any operating trouble whatever, and the high terms of indorsement in which the O. M. Edwards Company speaks of the electric drive is but one indication of the universal praise accorded the electric motor in the economic consideration of power problems.

Formal Opening of the Hudson River Tunnels.

Plans are being made for the formal opening of a part of the Hudson River tunnel system on February 25. It is expected that Governor Hughes, of New York, and Governor Fort, of New Jersey, will participate in the ceremonies, as well as representatives of the cities of New York and Hoboken, and various civic organizations in New Jersey. The tubes to be opened are operated by the Hudson & Manhattan Railroad, run from Hoboken, N. J., to Sixth avenue and Nineteenth street, New York city.

The finished section of the Hudson tunnels is a double-track railroad from Sixth avenue and Nineteenth street to the river, where the tracks run through tubes. The stations, which will be opened to the public after the official opening ceremonies, are at these points: Christopher and Greenwich streets, connecting with the Ninth avenue elevated; Christopher street and Sixth avenue, connecting with the Sixth avenue elevated; Fourteenth street and Sixth avenue and Nineteenth street and Sixth avenue. There are also stations at Twenty-third, Twenty-eighth and Thirty-third streets, but for the present trains will not run above Nineteenth street. A terminal structure is soon to be built on the west side of Sixth avenue, between Thirty-second and Thirty-third streets.

Eight-car trains will be run, and the time from Hoboken to Sixth avenue and Nineteenth street will be twelve minutes. The trains can make the run in seven minutes without much trouble. The fare will be five cents.

The platforms of the stations are so constructed that passengers may enter while others leave the cars. The cars have doors in the middle as well as at each end. The platforms on which the passengers leave the cars are separate from those on which they will enter. The car doors are so operated by compressed air that the train can not leave until the doors have all been closed.

RAPID COFFER-DAM EXCAVATION.

BY CHARLES M. RIPLEY.

The Economy Light and Power Company is constructing the foundations for a 10,000-horse-power hydroelectric plant at the point where the Desplaines River empties into the Kankakee River, the two forming the Illinois River. After the completion of the dam it is the opinion of the engineers that a full seventeen-foot drop will be gained which together with a flow of 10,000 cubic feet per second will be employed for the generation of electric power which will be marketed largely in Joliet, Ill.

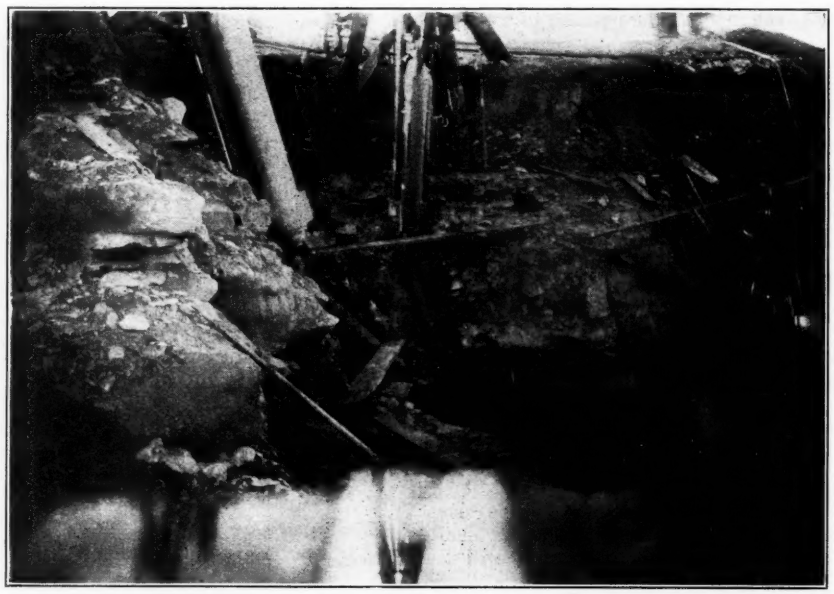
In the month of August, 1907, J. O. Heyworth, the general contractor, began to move his construction plant by fifty-ton barges down the Illinois and Michigan Canal, hauled by a twenty-four-horse-power Barber Brothers gasolene launch. In a period of three months' time the following work was done: A camp was built for the accommodation of about 200 men, a 7,000-yard U-shaped levee, which we will call coffer-dam No. 1, was thrown up; 5,500 yards of rock were also excavated from the power-plant site and placed in the cribs of the coffer-dam No. 2 beyond the levee, and the work pushed nearly to completion in about three months' time. The contractor's plant is described as follows: A Lidgerwood eight-and one-quarter-by-ten-inch hoisting engine at the side of the canal with a guy derrick for the unloading of the heavy machinery from the barges. This engine and derrick were also used in connection with the unloading of the barges of crushed stone, and a one-yard Hayward clam-shell bucket unloads three 180-ton barges in fourteen hours; thus all trucking to the job was eliminated.

An industrial railway enters the site of the excavation at the northeast corner in the form of a single track. It is fanned out into eight tracks on which Western dump cars carry out the excavated material, which is silt, glacial drift and sandstone underlying about nine feet. At the top of a ten per cent grade the single track runs level for about thirty feet, at which point an eight-and-one-quarter-by-ten-inch Lidgerwood double-drum, double-cylinder hoisting engine is located with the drums facing down the track. Two cables extend down into the excavation and thus one hoisting engine with one engineer attends to the removal of the material and is capable of moving two trains of six cars up or down the grade at the same time. After the cars get on the level track teams of horses haul them to the spoil bank.

One of the most interesting features of the work was the way the Page drag-scraper-excavating bucket was used both to run the levee around coffer-dam No. 1 and also to assist in filling cribs in coffer-dam No. 2. In the earlier stages of the work the two Page buckets, with their accompanying engines and derricks, were the first pieces of apparatus to begin excavation. The machines traveled on a track laid just within the limits of the excavation. In one operation dirt was dug, lifted and after the machine made a quarter turn, earth was dumped just beyond the excavation limits, making levee on three sides. Later these machines were run nearer the centre of the excavation and again, in one operation, they dug, hoisted and dumped as follows: The same one-yard special power-scraper bucket strung from the forty-foot boom of the derrick dug out the silt and glacial drift, part dry and part wet, and dropped part into the industrial cars and part was upset in a pile where laborers with wheelbarrows conveyed the dirt to make the earth fill in coffer-dam No. 2, further out in the river. Seven thousand yards of dirt and 5,000 yards of rock were excavated in a little less than two months and placed either in the spoil bank or in the coffer-dam. Thus excavated material from coffer-dam No. 1 was used in construction of coffer-dam No. 2 as well as making levee around coffer-dam No. 1.

In the rock excavation four Ingersoll-Rand inch-and-a-half steam drills were used, and decidedly heavy blasts were employed during the noon hour and after the end of the day. In that part of the excavation which was beyond the reach of the Page drag bucket, teams and scrapers were used and some pick-and-shovel work was done.

Four types of coffer-dam and levee construction were used. Type 1 was used running at approximately right angles to the Desplaines River for a distance of 120 feet back from the edge of the stream. Two-by-eight timbers were driven three feet into the ground, the joints broken and a top walling piece of three-by-six timber spiked to it, after which the earth fill was dumped on either side. Type 2 was used on the down-stream side of the coffer-dam for a distance of 110 feet out from the edge of the stream. Types 3 and 4 were used on the up-stream face of the coffer-dam where the full force of the fifteen-mile-an-hour current strikes it and also on the sides where the scouring effect of the stream is most dangerous. It is interesting to note that on the up-stream face of the coffer-dam, the level of the water is three and one-half or four feet higher than on the down-stream face, owing to the banking up of the water as it strikes at high velocity. The rock cribs are on both sides of this most critical point in the coffer-dam. These were built of heavy green maple, which almost sank as soon as launched in the stream above their final location. Three one-and-one-quarter-inch manila ropes were used to gradually



COFFER-DAM CONSTRUCTION. EMERSON STEAM PUMP IN SUMP HUNG IN A DIFFICULT PLACE.

locate each coffer-dam in place as the heavy current carried them down stream, one by one, into place.

As a further precaution against the destruction by the combined static and velocity heads of the water, a row of one-and-one-half-inch holes was drilled just inside of the up-stream side of the coffer-dam. Iron rods were driven into these to further act as an anchor to the stone cribs and prevent their being slid out of place.

It will be noted that the top of the coffer-dam is at about elevation seventy (Hennepin data) and that the excavation will be carried down to elevation thirty-six, or twenty feet below the average bottom of the river and twenty-four feet below the low-water level. It will thus be seen that the pumping problem is a very serious one. As yet coffer-dam No. 2 has not been drained since it is hardly completed. The U-shaped levee, however, which encloses coffer-dam No. 1, an area of about 50,000 square feet, is now at a level of about elevation forty-six, or fourteen feet below the present level of the river. The contractor, as shown in the accompanying sketch, has hung one No. 3 and one No. 4 Emerson steam pump from A frames, which have kept the excavation dry. During the drilling for blasting it frequently happened that subterranean springs were tapped and upon the withdrawal of the drill little one-and-one-half-inch geysers would spurt out, further complicating the pumping problem. The accompanying photograph shows one of the pumps operating with part of a strainer exposed above the surface of the water and taking air at every gulp.

The water power to be developed at this hydroelectric plant is supplied both by the regular flow of the Desplaines River and also by that of the Chicago Drainage Canal. This is made possible owing to the fact that the drainage canal discharges into the Desplaines River at a point above the location of the dam. In addition to this there is to be considerable storage of water above the power plant owing to the fact that the neck of land between the Desplaines and the Kankakee rivers will be turned into a reservoir by means of continuing the concrete dam now under process of construction, or in the form of a 500,000-cubic-yard levee reaching over toward the Kankakee River.

The rest of the contractor's plant consisted of two forty-horse-power vertical boilers, one for supplying the steam drills and the other for supplying the two Emerson pumps.

The equipment can be briefly summarized as follows:

Three eight - and - one - quarter - by-ten double-drum, double-cylinder Lidgerwood hoisting engines.

One nine-by-twelve Lambert double-drum engine.

One seven-and-one-half-by-ten Lambert double-drum engine.

Three Emerson steam pumps.

One Hayward clam-shell bucket, one-yard capacity.

Two Page & Schnable one-yard scraper-excavator bucket and derricks.

Four Ingersoll-Rand steam drills.

Two vertical boilers, about forty horse-power each.

Universal Portland cement.

Three Smith mixers.

One fifteen-ton locomotive crane, Browning Engine Company, of Cleveland.

Two fifty-ton barges.

One twenty-five-horse-power Barber Brothers gasolene tow-boat made seventy-seven round trips, thirty-four miles each, in eighty days, towing fifty-ton barge, locking through four locks each trip.

The engine has three cylinders, six and one-quarter by six and one-half-inch stroke, two-cycle; storage battery, six volts.

Government Copper Returns.

According to government reports the value of copper in all forms, not including ore, exported from the United States during 1907 exceeded $100,000,000. Shipments of ingots, bars, plates and old copper, which form the bulk of exports, were valued at $94,912,185. The year's shipments totaled 508,929,401 pounds, a gain of 50,000,000 pounds over the previous year. This is a falling off, however, from the record shipments of 535,000,000 pounds in 1905.

A total of 61,000,000 pounds of ore and matte, valued at $9,158,343, was imported last year, as compared with 49,000,000, valued at $6,796,696, in the previous year.

The General Meeting of the Electrical Committee of the Underwriters' National Electric Association.

The general meeting of the electrical committee of the Underwriters' National Electric Association will be held on Wednesday and Thursday, March 25 and 26, at the rooms of the New York Board of Fire Underwriters, 32 Nassau street, New York city. The electrical committee is composed of F. E. Cabot, chairman; W. A. Anderson, G. E. Bruen, H. C. Eddy, E. A. Fitzgerald, J. C. Forsyth, C. H. Hill, H. O. Lacount, Dana Pierce, William McDevitt, A. M. Schoen and C. M. Goddard.

American Civic Association Renews Its Fight to Preserve Scenic Niagara.

The campaign to preserve the scenic features of Niagara Falls has been reopened by the American Civic Association. The Burton law, passed in 1906, and operative for three years, limits to 160,000 horse-power the energy which may be taken from the Niagara River. Demands are being made on behalf of commercial interests to permit the diversion of more water from the river above the falls. The officers of the American Civic Association, J. Horace McFarland, Clinton Rogers Woodruff and William B. Howard, have presented several propositions to the President, and will later make similar arguments to Congress.

It is proposed to extend the Burton act for a further period of ten years. The Civic Association presents a plan which provides that the public ownership of the shores of the Niagara River should be extended to include everything between the head of the rapids and the end of the gorge, this control to extend everywhere far enough back from the brink to permit the maintenance of a permanent belt of forest trees sufficient to screen from the scenery of the river all the factories, houses and hotels and other structures upon adjacent private land; and that in future, structures needed in the development or utilization of power should be erected out of sight behind the enclosing belt of trees.

St. Louis Electrical Show.

The first St. Louis annual electrical show will be held at the new First Regiment Armory, St. Louis, Mo., under the management of the Trades Exposition Association, Limited, from April 18 to April 25. It is announced that diplomas will be awarded for the best displays and for the most unique inventions. It is expected that the Missouri and the Illinois Independent Telephone associations, the Missouri Electrical Contractors' Association and the Missouri Electric Light, Street Railway and Gas associations will hold conventions during this electrical week.

The Union Electric Light and Power Company will make a display of house lighting, and will fix up a cottage fitted with all conveniences in the form of utensils for the utilization of electricity for heating and cooking.

Hydroelectric Plants for Tokio, Japan.

The first 60,000-volt hydroelectric plant in Japan has just been put into service with signal success after having passed the rigid inspection which is required by the Japanese Government of all electrical installations. Power is obtained by impounding the Ugigawa River, a narrow and swift but deep river such as is often found in the mountainous portions of the Flowery Kingdom. The normal capacity of the main station is 18,000 kilowatts, and is furnished by six 3,000-kilowatt, fifty-cycle, 6,600-volt water-wheel-driven alternators.

The generator voltage is stepped up to the line voltage of 60,000 volts through three banks of three each single-phase, water-cooled, 2,000-kilowatt transformers, at which potential it is transmitted twenty-five miles to the Waseda substation just outside the city of Tokio. In this substation water-cooled transformers of 1,800 kilowatts each step down the line voltage to 11,000 volts, at which potential it is transmitted underground through lead-armored cables to eleven distributing substations situated in various parts of the city.

In each of these smaller substations oil-cooled transformers of 250 kilowatts' capacity step the voltage down to 2,000 volts, the line potential of the city circuits. The territory immediately surrounding the Waseda substation is also fed with low-voltage current for light and power purposes.

The entire transformer, regulating and controlling equipment, consisting of eighteen water-cooled and fifty-four oil-cooled transformers, eighty-one single-phase induction-feeder regulators and 149 switchboard panels, was furnished by the General Electric Company, as was also the lead-armored cable.

Another important Japanese hydroelectric development is described by United States Consul-General H. B. Miller, of Yokohama, who furnishes the following information respecting this proposed hydroelectric plant: The Minister of Home Affairs, on December 6, last year, granted a license to the Anglo-Japanese Oi-gawa Hydroelectric Power Company to establish a system of electrical supply for Shizuoka and other cities on the Tokaido, for which purpose the water power of the cataracts of the Oi River is to be used. The company is laying plans to develop 66,000 horse-power at Tamochimura, about 27,000 horse-power at a point between Ikama-mura and Hambaraumechi and about 8,000 horse-power at Uchinakubi. The second and third-mentioned powers are to be developed first, and the constructions, it is thought, will be started in 1908, the estimated cost being $5,000,000. Work on the largest plant will be postponed for some time. The company has a capital of $5,250,000, half subscribed for British and half for Japanese promoters.

Adopts Third Rail.

Frank J. Sprague has received confirmation by cable from M. Bertrand, Administrator of Traction and Material for the Belgian State Railways, that after long investigation it has been decided to adopt direct current and the third rail for the initial electric railway equipment at the Parc de Laeken, near Brussels.

This decision was made in accordance with the recommendations of a report by Em. Uytborck, electrical engineer of the government railways, who some months ago visited the United States, and spent considerable time investigating the operation of installations, visiting various manufacturing companies and fully acquainting himself with the state of electrification in this country.

License has been taken on behalf of the Belgian Government to use the Wilgus-Sprague type of protected third rail, and orders for much of the necessary material have already been placed in this country.

Ohio Public Utility Law.

The Shuler Public Utility Commission bill, as introduced in the House at Columbus, Ohio, provides for a commission of five members appointed by the governor for five years, each to receive a salary of $10,000 a year. The governor may remove for malfeasance or misfeasance in office after an open hearing. The bill provides that only indeterminate permits shall be given, to run as long as the corporation abides by regulations of the commission and by the ordinances of the city. The service must be adequate and charges just and reasonable.

Every corporation must agree to joint use, and if two corporations can not agree on terms the commission has power to prescribe them. Its decision may be reviewed by the courts.

The commission has power to fix values. Books and accounts must be open for inspection by the commission. Information in the possession of the commission shall be public except that it may withhold the same for a period of sixty days.

Every public utility corporation must file schedules showing rates, tolls, etc. No change may be made in rates except on consent of the commission. It must investigate every complant made by twenty-five electors when rates, tolls, etc., are called unreasonable, discriminatory or are insufficient and inadequate. Decisions in such cases are subject to review by the courts.

Important features of the bill are those dealing with the granting of permits and with municipal ownership. Companies now operating under grants will not be affected during the life of existing franchises.

The initiative for indeterminate grants rests with the council. If granted, twenty per cent of the electors may petition for review by the commission. Granted by the commission, the franchise shall not become operative for sixty days, and twenty per cent of the electors may petition for referendum.

Where an indeterminate grant has been made to one company no permit shall be granted to another company unless there is first secured from the commission a declaration that there is a necessity for competition.

The council may, by two-thirds vote, decide for municipal ownership. The question is then submitted to the electors, and must get approval of sixty per cent of those voting.

The commission has power to fix rates of telephone, electric lighting and gas companies and interurban railways, and power to regulate the issuance of stocks and bonds.

The bill abolishes operation of the consent law on streets where lines have existed.

Civil Service Examinations for New York State and County Service.

The New York State Civil Service Commission will hold examinations on March 7 for the following positions: Assistant inspector of gas, Public Service Commission, $1,080; engineering inspector, state architect's office, $2,250 and traveling expenses; tracer, state engineer's and state architect's offices, $480 to $900.

The last day for filing applications for these positions is February 29. Application blanks and full information may be obtained by addressing Chief Examiner Charles S. Fowler, Albany, N. Y.

Current Electrical News

DOMESTIC AND EXPORT.

MEXICAN ELECTRICAL NOTES—The president of the Torreon & Lerdo Electric Street Car Company, Lic. Sarinana, of Lerdo Dgo, announces that the company will construct a new line from Torreon, Mexico, direct to Lerdo. The company hopes to have the service ready inside of six months. The company has also announced that it will enlarge the capacity of the lighting system by installing a plant in Torreon near the Fundicion de Fierro. The Chinese of Torreon, backed by the Banco Chino y Mexico, also have a concession for the building of an electric line to run from the cemetery to Torreon Nuevo.

NORTH AMERICAN COMPANY TRANSFERS HOLDINGS—The North American Company has disposed of its holdings in the Milwaukee (Wis.) Heat, Light and Traction Company and the Milwaukee Electric Railway and Light Company, consisting of common stock of a par value of $9,000,000 to the Milwaukee Heat, Light and Traction Company, receiving in payment therefore the capital stock and refunding and extension mortgage bonds of the traction company. President C. W. Wetmore, of the North American Company, says the transfer was made in the belief that both the Milwaukee properties could be more effectively developed with the Milwaukee Heat, Light and Traction Company in control.

NEW ILLINOIS INTERURBAN—The secretary of state of Illinois has issued a license to incorporate to the Mississippi Valley Interurban Railway Company. The capital stock is $1,000,000. The object is to construct an interurban railroad from Springfield, through Petersburg, Virginia, Rushville and Mount Sterling to Quincy; from Mount Sterling to Pittsfield, Hardin, Jerseyville, Winchester, Jacksonville and Hillsboro; from Hillsboro to Greenville and Shelbyville, through Owanco and Vandalia, and from Greenville to Carlisle, Nashville, Pinckneyville and Murphysboro. The incorporators are James H. Ward, of Butler, Ill.; George E. Watson, of Hillsboro, Ill.; H. R. Lakin, of Rochester, Ill., and John F. Melick and F. A. Melick, of Springfield, Ill.

EXTENSIVE WESTERN POWER DEVELOPMENT PLANNED BY THE STONE & WEBSTER INTERESTS—The consolidation of the Seattle-Tacoma Power Company with the Stone & Webster interests is part of the plan of the eastern company to secure control of a chain of power plants in the Puget Sound country. The White River plant, with a capacity of 100,000 horse-power, will be completed at once. This, with the plants at Electron and Snoqualmie Falls, and others to be built or acquired, will give Stone & Webster interests control of 150,000 horse-power. Power from the combined plants will furnish current for a chain of electric railways from Bellingham to Everett, Seattle, Tacoma, Olympia, Grays Harbor, Portland and intermediate points.

UNITED STATES INDEPENDENT TELEPHONE COMPANY—The properties of the United States Independent Telephone Company, Rochester, N. Y., were bid in by the reorganization committee of the bondholders at the public foreclosure sale on February 4 by Chairman Walter P. Duffy, of the committee, for $250,000. Later the reorganization committee of the United States Independent bondholders bought in the properties of the Independent Telephone Securities Company, comprising the Rome, Syracuse and Utica companies, at the foreclosure sale, for $150,000. It is estimated that the non-assenting bondholders of the telephone company will receive $12.50 for one $1,000 bond, and the non-assenting bondholders of the securities company will receive $100 for one $1,000 bond. The Independent Telephone Company had a capital stock of $4,782,000 and a bond issue of $13,362,000 bearing five per cent per annum.

LONG TUNNEL FOR CALIFORNIA ROAD—Eli P. Clark, who is building the Mount Hood electric railway from Portland to Bull Run, has begun the construction, at Los Angeles, of one of the most remarkable tunnels on the western continent. It will be a four-track electric railway tunnel, a little more than nine miles long, extending under the city of Los Angeles and giving an outlet for the beach lines of the Los Angeles & Pacific railway system. The tunnel will cost $4,000,000. The trip between Los Angeles and Santa Monica is retarded by the necessity for running trains slowly through the city, and the lost time has to be made up by the run south after passing the junction of the Sherman line branch to the oil fields. This junction is about eight miles out from the city. The company will erect a twenty-two-story building and passenger station at the entrance of the tunnel, which is near the centre of the business district of Los Angeles.

NEW WASHINGTON POWER PLANT COMPLETED—The work of installing machinery in the power plant of the Hanford Irrigation and Power Company, a Seattle corporation, of which W. R. Rust, of the Tacoma Smelting Company, is president, is nearly completed. It will have a capacity of 20,000 horse-power and is capable of later developing 400,000 horse-power. The plant is located at Priest Rapids, on the Columbia River, east of North Yakima. The canal to irrigate 16,000 acres of land will begin its service to that acreage on April 1. The work is practically done. It was constructed with a view to irrigating another 16,000 acres with a small additional expenditure next year. This company has also completed a pumping station at Coyote Rapids, on the Columbia River, twenty miles below Priest Rapids, and has already completed the line for the transmission of power from the Priest Rapids plant to this station.

CALIFORNIA LIGHTING COMPANIES MERGE—A deal involving $45,000,000 was consummated on January 30 when a mortgage and deed of trust for that amount from the California Gas and Electric Corporation were given to the Union Trust Company, of San Francisco, Cal. The interests and properties of all gas and electric lighting and power companies of San Francisco and Central California were merged, and one corporation was given control of the gas and electric plants in twenty-five counties of California. Of $45,000,000 in bonds authorized, the sum of $38,282,000 is reserved for refunding the underlying bonds of the companies making the transfer. Of the remainder, $3,055,000 of bonds is to be applied to take up the floating debt of the California Gas and Electric Corporation, when evidence thereof is given to the trustee, and $3,058,000 of the bonds is to be issued for immediate or future improvements at the rate of eighty-five per cent for each $100 of work done. Captain A. H. Payson, I. W. Hellman, Jr., and C. O. G. Miller, composing the bondholders' committee, after investigation, gave consent to the execution of the mortgage. The bonds will be issued in different denominations for thirty years, expiring 1937, and bear interest at the rate of five per cent a year.

LONG ACRE ELECTRIC LIGHT AND POWER COMPANY PLANS INCREASE IN CAPITAL—The New York Public Service Commission for the First District has designated Commissioner Maltbie to hold a hearing on an application from the Long Acre Electric Light and Power Company for the approval of an issue of $10,000,000 preferred stock and $50,000,000 bonds. It is set forth in the petition that the company has the right, under a city franchise, to place wires for electric light, heat and power in the boroughs of Manhattan and the Bronx. It has a small plant in operation at Forty-seventh Street and Second Avenue, New York city, and is actually engaged in supplying electric current to customers. Authority is asked to issue $10,000,000 of preferred stock, the rate of dividend thereon to be seven per cent, the stock to be non-cumulative and non-voting. Of the $50,000,000 in bonds, only $12,000,000 is to be issued at this time. This is to be secured by a mortgage on all the property of the company, its franchises and rights, and is to bear six per cent. The bonds are to be redeemable at 110 and interest at any time, and the mortgage is to contain a sinking fund clause. It is planned to use the proceeds of the bond issue to retire the present issue, to acquire property

upon which to erect power-houses and substations, to construct power-houses and substations, and to purchase and lay underground cables. It is understood that the Manhattan Transit Company, which holds a franchise for a tunnel under the East River to Brooklyn, is the chief stockholder in the company. The officers are: Edgar Van Etten, president; John C. Sheehan, vice-president; W. W. Walters, secretary and treasurer; C. B. Corbin, assistant secretary and treasurer.

SOUTHERN NEW ENGLAND TELEPHONE COMPANY—At the annual meeting of the Southern New England Telephone Company the directors were authorized to issue at their discretion $2,000,000 capital stock. This with $300,000 of new stock that has already been authorized by the stockholders, but not yet issued, will bring the capital stock of the telephone company up to $10,000,000, the limit under the present authority of the legislature. The new stock will be sold to stockholders at par and will be issued only at such times as the directors feel the need of the money to carry out improvements and additions to the plant. The stockholders also voted amendments under which the directors may elect more than one vice-president whenever they see fit to do so, and also to appoint an executive committee composed of directors of the company. The report shows earnings from exchange service of $1,565,095 as compared with $1,323,990 the previous year; earnings from toll line and long-distance service were $527,672 as compared with $449,571; general operating expenses were $298,019 as compared with $263,608, corresponding figures for operating expense being $463,772 and $387,458; for maintenance $773,393 and $651,356; for interest $64,469 and $87,738. Total earnings from all sources for the year were $2,123,707 as compared with $1,829,143 the previous year. Net revenue was $423,615 as compared with $351,514 and surplus over dividends $21,589 as compared with $44,014 the previous year. The statement shows that the actual amount paid in royalties to the American Telephone and Telegraph Company is $33,676, after long-distance earnings from that company are subtracted. The report gives a history of the company for the past twenty years showing that the number of telephone stations has risen in Connecticut from less than 5,800 in 1888 to some 60,700, and rates during the same time have been reduced from $67.58 per station to $26.35 a station. The increase in stations in Connecticut during the year was about 8,200. It is stated that additional funds will be needed in considerable amount for the extension of business, but that nevertheless dividends are not likely in any degree to be reduced. The report estimates that ten per cent of the present capital, or $770,000, will be needed this year for the development of business, but will not be required for the present.

NEW PUBLICATIONS.

A STUDY OF ROOF TRUSSES—The Engineering Experiment Station of the University of Illinois has issued, as Bulletin No. 16, "A Study of Roof Trusses," by N. Clifford Ricker, professor of architecture at the university.

BURNING OF COAL WITHOUT SMOKE IN BOILER PLANTS—The United States Geological Survey has issued Bulletin No. 334 dealing with the burning of soft coal without smoke in boiler plants. This is a preliminary report prepared by D. T. Randall, which discusses the general condition now existing in this country, city ordinances for smoke prevention and the proper methods of handling furnaces so as to prevent smoke. This bulletin also contains a bibliography of articles on this problem.

PAPERS ON PRODUCER-GAS POWER PLANT, COAL-BRIQUETTING AND COAL-MINE SAMPLING—The United States Geological Survey has issued Bulletin No. 316, which contains four papers: The first dealing with the "Present Status of the Producer-Gas Power Plant in the United States," by R. H. Fernald; the second on the "Condition of the Coal-Briquetting Industry in the United States," by E. W. Parker; the third on the "Importance of Uniform and Systematic Coal-Mine Sampling," by J. S. Burrows, and the fourth, "A Classified List of Papers Dealing with Coal, Coke, Lignite and Peat," contained in publications of the United States Geological Survey, which has been compiled by W. T. Lee and J. M. Nickles.

TELEPHONE AND TELEGRAPH.

CONCORD, N. H.—Notice has been filed with the secretary of state by the Baker River Telephone Company of an increase in its capital stock from $20,000 to $25,000.

SAVANNAH, GA.—The announcement has been made that the Bell Telephone Company had bought out the Georgia Telephone Company, an independent company established ten years ago.

MIDDLETOWN, N. Y.—The large switchboard in the central telephone office of the Orange County Telephone Company was destroyed by fire on February 5 and the city is without telephone service.

PITTSBURG, PA.—It is stated that as soon as the workmen of the Clark Wireless Telegraph and Telephone Company have finished work now being done to establish wireless plants at Sault Ste. Marie, Mich., and Duluth, Minn., work will be commenced to establish the system in this city. At present the company has stations at Buffalo, Cleveland, Toledo, Detroit and Port Huron.

GALESBURG, ILL.—The Galesburg Telephone Company will this spring begin construction of many new toll lines that will give it connection with all the important cities of the state. The proposed extensions from Galesburg will touch Peoria, Moline, Rock Island, Davenport, Springfield, Streator, Elgin, Joliet, Aurora, Rockford and many other cities of importance. The plant also contemplates a connection with St. Louis. The company has appropriated $30,000 for this extension.

CLINTON, IOWA—The Clinton council has passed an ordinance requiring the placing of telephone wires in the city under ground. The Iowa Telephone Company announces that at an expense of $175,000 it will build and equip a modern, fireproof, concrete, reinforced building in Clinton, and will place in underground conduits all of its wires throughout the city. The wires of the Tri-City Telephone Company also will go under ground. The work will be undertaken in the spring, and will be pushed rapidly to completion during the spring and summer.

CANTERBURY, N. H.—The Citizens' Telephone Company will extend its line to Loudon village. The Canterbury & Boscawen Telephone Company recently held its annual meeting at which reports were rendered and officers chosen. The following officers were elected: President, T. C. Clough; vice-president, J. F. French. Directors, T. C. Clough, C. W. Carter, A. H. Brown, A. F. Drew and G. J. Sargent. At a directors' meeting A. F. Drew was chosen secretary and treasurer, and G. J. Sargent general manager. A six per cent dividend was declared on all stock of record January 1.

SPOKANE, WASH.—J. M. Welty, of Metaline, Wash., north of Spokane, has applied to the board of commissioners of Stevens county for a thirty-year franchise to build a telephone line between Metaline and Colville. He wants the citizens of Colville to organize a company for the purpose of building and operating telephone lines throughout the county, and has $1,500 pledged from Metaline, and seven miles of wire and material to proceed immediately on the construction of the line between Metaline and Ione. Mr. Welty was for five years construction foreman and inspector in eastern Washington and Oregon for the Pacific Telephone Company, with headquarters at Spokane.

MARIETTA, OHIO—At the annual meeting of the Marietta Telephone Company the following directors were re-elected: A. L. Gracey, I. O. Alcorn, J. S. H. Torner and W. H. H. Jett, of Marietta; J. H. Lininger, of Harrisville, W. Va.; J. P. Sharp, of Waverly, W. Va.; A. C. Davis and C. D. Jeffers, of Parkersburg. Mr. Gracey was elected president; J. S. H. Torner, vice-president; W. J. Speer, treasurer; A. C. Davis, secretary and general manager; W. W. McMahon, assistant manager, and J. C. Brenan, attorney. Business for the past year was gone over, the improvements which are about to be completed discussed, and plans for the future received attention. The Marietta company is rapidly becoming one of the important independent telephone concerns in this part of the country. During the past year many improvements have been made.

ELECTRIC LIGHTING.

ELNORA, IND.—The electric light plant was destroyed by fire on January 27. The property was not insured.

LIMA, OHIO—Maus Brothers, of Lafayette, are installing an electric light plant in that town which will supply the village of Harrod, nine miles distant.

BELLEVILLE, OHIO—The Belleville electric light plant, owned by Theodore L. Garber & Sons, burned on January 30. The loss is partly covered by insurance.

PARSONS, PA.—The Standard Electric Light Company, of Parsons, has been awarded a contract to furnish the borough with twenty street arc lamps at $70 each per year.

MANSFIELD, MASS.—The electric light commissioners have filed their report of the summary of the year's work. For the ensuing year they recommend the appropriation of $4,000 and receipts for maintenance.

CASHTON, WIS.—Voters of this village have carried a proposition to bond the village for $15,000 for the construction of a municipal lighting plant. An old mill property will be purchased and fitted up as a power plant.

EMPORIA, KAN.—During the six months just past the city electric light plant has earned above expenses, $4,793.33. Of this amount $2,168.18 was expended for permanent extensions and improvements which are figured as profits.

COLUMBUS, NEB.—The city council has passed the ordinance granting to John T. Burke, a twenty-year franchise for an electric light and power plant. The city council also entered into a five-year contract with Burke for lighting the streets of the city.

WARREN, OHIO—The Peerless Electric Company has purchased the mills at Newton Falls, Leavittsburg and Parkman. It is the intention of the company to erect a large power plant at Newton Falls to supply electric power not only to its own factory, but to the surrounding towns.

WEST POINT, NEB.—The new directorate of the West Point Electric Light and Power Company is as follows: W. A. Black, William Stuefer, John Meier, J. T. Baumann and Henry Mumker. The officers are: President, W. A. Black; vice-president, John Meier; secretary-treasurer, J. T. Baumann.

NILES, MICH.—The council has granted to the Indiana & Michigan Electric Company a franchise for the transmission and distribution of electric energy for manufacturing purposes. It is expected that current will be sold to manufacturers at a price much below the cost of producing steam power.

BATH, N. Y.—The Bath Citizens' Electric Service Company has been granted a franchise by the neighboring villages of Avoca and Savona to supply the street lights for those places. The company is preparing to install its plant for lighting the streets of Bath, and is expected to be ready to begin operations by May 1.

OXNARD, CAL.—The Ventura County Power Company is now receiving its power for the entire county system over the high-voltage line of the Edison company at Castaic, sixty miles away. The transmission is at 30,000 volts. The power-houses already erected in the county will only be used in case of emergency.

PORTAGE, WIS.—The Portage Electric Light Company has made application to the state railroad commission for permission to lower its schedule of rates in this city. The present rate is from fifteen cents to ten cents per 1,000 watts. On business houses the new rate asked for is from ten cents to six cents per 1,000 watts.

SACRAMENTO, CAL.—It has been decided by the board of trustees to accept the proposition of the Sacramento Electric, Gas and Railway Company to furnish lights for the city during the following year at the rate of $6.30 a month each, and to abandon for the present at least the proposition of erecting a municipal lighting plant.

LEWISBURG, TENN.—Lewisburg having made such growth during the past few years the city authorities now find that the present electric light system is entirely insufficient to meet the demands. A committee has been appointed which will take steps at once to have Lewisburg lighted by electricity generated either at Wilhoite or Lillard's Mills, on Duck River.

LOUISVILLE, KY.—President F. M. Sackett, of the Louisville Lighting Company, is authority for the statement that plans are under way for improvements to the system to cost more than $1,500,000. The capacity of the plant at Fourteenth and Magazine streets will be increased to 9,800 kilowatts, and that of the Tenth street auxiliary plant to 1,950 kilowatts.

PATCHOGUE, N. Y.—A local syndicate has secured control of the Patchogue Electric Company. J. F. Heyward, promoter of the original South Shore Traction Company, bought it years ago for $50,000. The local syndicate gets it for $40,000 and will install a duplicate plant giving an all-day and improved service to its patrons. E. Eugene Hawkins, Jr., is the new president.

SAN JOSE, CAL.—The common council has decided to enter into a five-year contract with the United Gas and Electric Company for lighting the streets of the city. This contract, which is more advantageous to the city than any previous contract, provides for 277 arc lamps, as at present lighted, upon the Humphreys moonlight schedule, all night, at $3.50 per light per month.

WAUSAU, WIS.—Negotiations are under way for the purchase of the Wausau Electric Company's plant by the Wausau Street Railroad Company. The street railway company is also negotiating for the purchase of the Joseph Dessert water power at Mosinee. If this deal is closed it is the intention of the company to erect a power-house and transmit power to Wausau manufacturers.

IONIA, MICH.—The Ionia Water Power and Electric Company will light the city of Ionia for another year. The lighting committee presented to the council a new contract, which is substantially a renewal of the old one, for seventy-one arc lights at $52.50 per lamp and $22.50 additional for all-night lamps. The contract was ratified by the council, taking effect from December 1, 1907.

CRAWFORDSVILLE, IND.—The city council has refused an offer of $57,632.33 for the electric light plant, which for the last seventeen years has been operated under municipal ownership. Some few weeks ago an offer of $46,000 was made for the plant. Appraisers fixed a value on the plant of $57,632.33. The previous offer of $46,000 was then increased to equal the amount of the appraisement.

CONCONULLY, WASH.—The county commissioners have granted the franchise asked for by the Similkameen Power Company, with the exception of the towns of Oroville and Bolster, whose citizens objected. The term of the franchise is for fifty year, and grants the right to construct and operate lines for the transmission of electricity throughout the greater portion of Okanogan County.

ST. LOUIS, MO.—John I. Beggs has been re-elected president of the Laclede Gas Light Company. August Gehner was elected one of the vice-presidents to take the place of Breckinridge Jones. P. E. Bisland, of New York, the other vice-president, was re-elected. The remainder of the officers also were re-elected, as follows: Secretary, C. L. Holman; treasurer, William S. Dodd; assistant secretary, H. F. Kroyer, of New York; assistant treasurer, E. D. Pray.

SHERBROOKE, QUEBEC—At the annual meeting of the Sherbrooke Power, Light and Heat Company the directors' report of the year's business was very satisfactory. The important feature was the carrying of a motion to sell the company's plant and business to the city. Under its terms the company undertakes to sell to the city at any time before the second of July at a price to yield the stockholders $85 a share, the city to assume the company's bonds.

AUGUSTA, ME.—At the annual meeting of the stockholders of the Kennebec Light and Heat Company officers were chosen for the year as follows: President, George F. West, of Portland; clerk and treasurer, Samuel Cony Manley, of Augusta; superintendent, William H. Williams, of Augusta. Directors: Henry B. Cleaves, George F. West, E. R. Payson and George W. Beyer, of Portland; Josiah S. Maxcy, of Gardiner; Charles H. White and Guy P. Gannett, of Augusta.

OAKLAND, CAL.—Through E. M. Downer, of Pinole, the Great Western Power Company has been granted a general franchise by

the board of supervisors to install and maintain on the county roads and highways, poles and wires for electrical transmission. The franchise runs for fifty years. Under its terms two per cent of the gross income collected for the current sent over the lines under the franchise shall be paid into the county treasury after five years of operation.

RAPID CITY, S. D.—Rapid Creek, the largest stream in the Black Hills, will be harnessed so as to furnish electric power to Rapid City and the mining camps of the hills. A local organization, the Dakota Power Company, has been organized, and is now at work constructing a flume and ditches and as soon as spring opens up will begin the erection of a large power-house about twelve miles west of this city. The city has granted the company a franchise to locate and operate in the city, light, power and heat works and appliances.

WEST CHESTER, PA.—The White Clay Creek Electric Light and Power Company, which has operated a plant on the White Clay Creek, has purchased the water power at Rudolph's Mill, on the Big Elk, and will construct an additional plant at that place. It is believed that by constructing a high breastwork between the two bluffs, one of the finest water powers in Chester County can be developed. The company, it is said, will then extend its light and power to Strickersville, New London, Kelton and other villages in the southern part of Chester County.

MINNEAPOLIS, MINN.—The Minnesota Power and Trolley Company desires a franchise for sale and distribution of electric energy in Minneapolis. Judge L. W. Collins appeared before the council electric committee and said that with acceptable conditions his clients would enter the electric lighting and power field with 90,000 horse-power, obtained from riparian rights owned by the corporation along the waterways of the state. Judge Collins declared he was authorized to accept for his principals the rates agreed upon by the city and the General Electric Company. It is understood that J. G. White, of J. G. White & Company, engineers, New York, is a prominent factor in the company.

FERGUSON, MO.—At a mass meeting held in the Ferguson city hall $15,000 was subscribed with which to build an electric light plant to supply Ferguson with light. The company will be known as the Ferguson Electric and Supply Company, and will be capitalized at $15,000, divided into $10 shares. J. Goode Cabanne was appointed by Chairman J. H. Kineally to petition the city council for a franchise, and the work of building the plant will be pushed. The organizing of the new plant is due directly to a fifteen-cent-per-kilowatt-hour rate charged by supplying companies. The company will be co-operative, all the stock being sold to residents of Ferguson, and the rate charged will be ten cents per kilowatt-hour.

REDLANDS, CAL.—The Redlands Home Gas and Electric Company held its annual meeting recently. Reports showed excellent earnings for the two plants, which have been in operation only a year. The company now has in excess of 2,000 customers for gas and electricity, and during the year $90,000 has been expended in extensions to the system and in power wires to San Bernardino and other places where electricity is furnished. The officers and directors chosen for the coming year are: President, C. S. Chesnut; vice-presidents, C. E. Taylor and Arthur Gregory; secretary, Delmont Locke; general manager, F. P. Meserve. Others directors: W. R. Cheney, John F. Dostal, H. P. Walton, N. Leo Lelean and G. W. Foreman.

MISSOULA, MONT.—The Clark-Montana Realty Company has completed its dam at Bonner and the waters of the Blackfoot and Hell Gate rivers are harnessed just below their confluence. The dam is 600 feet in length, ninety-six feet wide at the foundation, and thirty feet in height from low-water mark, constructed of rock-filled cribbing. The power-house, constructed nearly at the centre of the dam on its lower side, is 126 by fifty feet, inside dimensions, and constructed entirely of concrete and steel. Each dynamo is of 900 horse-power. This will make the capacity of the plant, as now equipped, 2,700 horse-power—all that is necessary for the present. The plant, when completed, will have cost $400,000. Power is to be furnished for an interurban electric railway and for manufacturing plants in Missoula.

OBITUARY NOTES.

MR. THURLOW WEED SEWARD died on February 1 at his home, 213 St. James place, Brooklyn, N. Y. He had been in charge of the burglar-alarm system of the American District Telegraph Company for the last thirty-six years. He leaves a widow, two sons and a daughter.

MR. JOHN C. HUBINGER, prominently identified with pioneer independent telephone interests in St. Paul and Minneapolis, Minn., died recently at Keokuk, Iowa, of pneumonia. Mr. Hubinger secured the franchise for the Mississippi Valley Telephone Company, the predecessor of the present Tri-State Telephone and Telegraph Company.

MR. GEORGE THOMAS DUNLOP, president of the Capital Traction Company, of Washington, D. C., died on February 5, after a long illness. Mr. Dunlop was born at Otterburn, Md., March 25, 1845. He had been president of the Capital system since 1895, and was prominently identified with other large business interests of Washington.

MR. CHARLES B. ELLIOTT, an electrical and mechanical engineer, died on February 1 at St. Francis Hospital, Jersey City, N. J., in his fiftieth year. He had a plant at 87 Sussex street and lived at 264 Academy street. Mr. Elliott was formerly a member of the firm of Crane & Elliott, proprietors of a machine shop in Chicago. He was the first general electrical engineer for the Pullman Palace Car Company and had charge of the lighting plants on the Pennsylvania Railroad expresses running between New York and Chicago. He was employed by the government as an electrician at the Brooklyn Navy Yard for many years, and had charge of the installation of wireless telegraph stations at Montauk Point and Cape Cod. He went to Cuba for the government and installed a wireless station there. Mr. Elliott established a business in Jersey City a year ago. He leaves no immediate relatives.

MR. OTHNIEL F. NICHOLS, one of the consulting engineers of the Department of Bridges, New York city, died suddenly of apoplexy on Tuesday, February 4, at his home in Brooklyn, N. Y. Mr. Nichols was born on July 29, 1845, in Newport, R. I. He was graduated as a civil engineer from the Rensselaer Polytechnic Institute in 1868, and began his professional career in the laying out of Prospect Park in Brooklyn and the construction of the first elevated railroad in New York city. In 1870 he became assistant engineer in the office of Cooper & Hewitt, and in the following year went to Peru, where he spent four years in the tunnel work of the Chimbote Railroad. On his return from Peru Mr. Nichols served as assistant engineer for the Edgemoor Bridge Works in the construction of the Metropolitan Railway, and was also employed by New York city as engineer in charge of the main drainage sewer in what was then called the "Annexed District." In 1878 he went to Brazil as resident engineer for an English railroad enterprise, and on his return the following year re-entered the employ of Cooper & Hewitt. He subsequently supervised the construction of the Henderson Bridge over the Ohio River, and served as chief engineer of the Waterworks Company, of Westerly, R. I. He resigned from the latter position to become assistant engineer of the Williamsburgh Bridge, and in 1903 was appointed chief engineer of the Department of Bridges of the City of New York, and later was appointed one of the consulting engineers.

NEW MANUFACTURING COMPANIES.

DOVER, DEL.—The United States Electric Rock Drill Company has been incorporated with a capital of $300,000. The incorporators are: T. H. Carmichael, R. A. Towden, Philadelphia, Pa.; J. A. Longstreet, Germantown, Pa.

BOSTON, MASS.—The Clapp-Eastham Company has been incorporated with a capital of $10,000 to deal in electrical machinery. The president is J. Emory Clapp; treasurer, O. Kerro Luscomb; clerk, Melville Eastham, all of Boston.

SALT LAKE CITY, UTAH—The National Electric Heater Company, with a capital stock of $50,000, in shares valued at $1, has filed articles of incorporation in the office of the county clerk. The company takes over from Charles P. Marsden and Walter Wright a patent on a certain electric sad iron, together with the necessary molds, patterns and dies. The officers of the company are: Walter Wright, president; Charles P. Marsden, vice-president; A. W. Morrison, secretary, and Ernest Wright, treasurer.

PERSONAL MENTION.

MR. LEVERETT VINER, chief engineer of the Uxbridge & Northbridge Electric Company, has resigned his position to take effect at once. He will be succeeded by George S. Davis.

MR. HERBERT H. VREELAND, for the last ten years president of the New York Railroad Club, was presented on February 7 with a silver loving cup as a testimonial of the esteem in which he is held by the club.

MR. HENRY SANGER SNOW has resigned as treasurer of the New York & New Jersey Telephone Company, and, it is understood, will be succeeded by Mr. A. E. Greene, who has recently been the acting treasurer of the company.

MR. GEORGE S. RANKIN, president of the Yakima Valley Trust Company Bank, has been chosen general manager of the Yakima Valley Transportation Company, a new street-car company at North Yakima, Wash.

MR. FRANK N. BROWN, of the Pawtucket (R. I.) Street Railway Company, it is announced, is to be general manager of the New York, New Haven & Hartford Street Railway lines south of Woonsocket, R. I., comprising about 110 miles.

MR. VAN RENSSELAER LANSINGH delivered a lecture on "Practical Illumination," in the assembly hall of the Chamber of Commerce at Rochester, N. Y., on January 29, at a meeting held under the auspices of the promotion of trade committee of the Chamber of Commerce.

MR. ARTHUR L. KELLEY was elected president of the Narragansett Electric Lighting Company, Providence, R. I., at a meeting of the stockholders held on February 5. He succeeds Marsden J. Perry, who resigned recently. Resolutions eulogizing Mr. Perry were adopted by the meeting.

NEW INCORPORATIONS.

ALBANY, N. Y.—United Wireless Telegraph Company, of New York. $5,000.

LANSING, MICH.—Chippewa Lake Telephone Company, Chippewa Lake. $2,000.

NORTH YAKIMA, WASH.—Naches Light and Water Company. $10,000. Incorporators: James Barnes, J. E. Boyle and F. A. Luce. To furnish light and water to Naches City.

DOVER, DEL.—The West Chester & Wilmington Electric Railway Company. $200,000. Incorporators: T. E. O'Connell, C. P. Faucett, West Chester, Pa.; F. H. Day, M. D., Talleyville; I. E. Elliott, H. D. Ross, Wilmington.

ALBANY, N. Y.—The Rural Home Telephone Company, Coeymans. $1,500. Directors: Jefferson Powell, Amos D. Briggs, Alcove; Lindsey Greene, Indian Fields; E. S. Palmer, Harry Shean, Coeymans; Stephen Tompkins, Alden Nodine, Ravena.

ELECTRICAL SECURITIES.

Narrow and dull, speculatively, the market continued last week to show little or no life, and but few gains were made, even in the best lines of securities. The proximity of the time for assimilating the $50,000,000 bond issue of the city of New York hardened the bond and investing market, and until this is disposed of and out of the way there will hardly be much recorded. A more cheerful look appeared upon the face of things in the reports of a number of large plants, which had been shut down temporarily, resuming work. Collections, too, seem to be improved, and there are indications that several of the suspended banking institutions in New York and elsewhere have arranged with depositors to open once more on a deferred-payment basis—in fact, the First National of Brooklyn really did resume business on February 10. The views expressed by Mr. Bryan at the recent Economic Club dinner in New York city, anent the need for, and the character of, currency legislation, while having gained supporters at the moment, are steadily losing virtue. In any event the happenings of the last few months will make certain that this question will be thoroughly sounded and investigated and a solution reached that will be fitting in view of the inherent strength and prosperity of this nation.

Dividends have been declared upon the following electrical securities: Philadelphia Company; regular semi-annual dividend of 2½ per cent on the preferred stock, payable March 2.

ELECTRICAL SECURITIES FOR THE WEEK ENDED FEBRUARY 8.

New York:	*Closing.*
Allis-Chalmers common	6
Allis-Chalmers preferred	18
Brooklyn Rapid Transit	39¾
Consolidated Gas	95
General Electric	115½
Interborough-Metropolitan common	7¼
Interborough-Metropolitan preferred	19½
Kings County Electric	95
Mackay Companies (Postal Telegraph and Cables) common	52¾
Mackay Companies (Postal Telegraph and Cables) preferred	61
Manhattan Elevated	125
Metropolitan Street Railway	15
New York & New Jersey Telephone	98
Western Union	53½
Westinghouse Manufacturing Company	40

The directors of the Kings County Electric Light and Power Company have declared the regular quarterly dividend of 2 per cent payable March 1. Books close February 21 and reopen March 2.

Boston:	*Closing.*
American Telephone and Telegraph	106¼
Edison Electric Illuminating	207
Massachusetts Electric	—
New England Telephone	109
Western Telephone and Telegraph preferred	62½

Gross earnings of the Massachusetts Electric Companies for January showed a slight increase of less than ½ per cent over the January, 1907, results. December gross earnings showed a decrease of something less than 1 per cent from the results of the corresponding month of the previous year. This improvement is the result entirely of favorable weather. There has been no improvement in the business situation substantial enough to warrant the hope of the current quarter more than breaking even with last year, unless the weather continues extremely favorable.

Philadelphia:	*Closing.*
Electric Company of America	8¾
Electric Storage Battery common	27
Electric Storage Battery preferred	27
Philadelphia Electric	5⅝
Philadelphia Rapid Transit	15½
United Gas Improvement	77

Chicago:	*Closing.*
Chicago Telephone	115½
Commonwealth Edison	86
Metropolitan Elevated preferred	49½
National Carbon common	55
National Carbon preferred	103

The Chicago Telephone Company in January gained 3,075 telephones. The total number now in use is 205,756.

The Chicago & Oak Park Elevated Railroad Company has issued its annual report for the year ended June 30, 1907. The income account is as follows: Passenger earnings, $869,866; other earnings, $22,703; total earnings, $892,569; expenses, $527,180; net, $365,389; interest, rents, etc., $429,334; deficit, $63,945. President Knight says: "Train mileage increased during the year 58,031; car mileage increased 100,660; the operating ratio was 59.07 per cent. This year the road will be extended west of Oak Park which will add enough to passenger traffic to wipe out the deficit. An independent organization will complete this extension, but must give the Oak Park Elevated five cents per passenger."

The Metropolitan West Side Elevated Railroad Company has issued its annual report for the year ended December 31, 1907. The income account is as follows: Gross, $2,878,587; expenses, $1,443,498; net, $1,435,089; other income, $6,819; total income, $1,441,908; charges, $1,050,123; surplus, $391,785; dividends, $195,927; surplus, $195,858; previous surplus, $1,320,291; total surplus, $1,516,149. The total passengers carried aggregated 54,200,888, or a daily average of 148,715, an increase over 1906 of 9.06 per cent. Maintenance of way and structure expenditures were $115,714; maintenance of equipment, $194,724; conducting transportation, $937,292; general expenses, $88,140; loop expenses, $107,627; total, $1,443,498. Metropolitan Elevated directors have been re-elected.

ELECTRIC RAILWAYS.

BABYLON, N. Y.—The South Shore Traction Company has been granted a franchise by the village board.

PORT HURON, MICH.—At the annual meeting of the stockholders of the Sarnia Street Railway Company it was decided to make many extensions to the lines during the coming year.

BROOKLYN, N. Y.—The Coney Island & Brooklyn Railroad Company has asked permission from the Public Service Commission to issue $30,000 worth of six per cent mortgage bonds to pay the cost of ten new cars.

EVANSVILLE, IND.—C. M. Shanks, of Indianapolis, attorney for the Grand Central Traction Company, that proposes to build an electric line from Indianapolis to this city, has asked the board of public works for a franchise. He says work on the proposed road will commence not later than March 31.

SPARTANBURG, S. C.—The books of subscription of capital stock of the Greenville & Spartanburg Electric Railway Company will be opened March 4. The company will have capital stock of $100,000. The company will build an electric line from Greenville to Spartanburg and will pass through all the large towns between those points.

MILWAUKEE, WIS.—The extension of the interurban electric railway from Oconomowoc to Watertown will be resumed as soon as the weather will permit, and President John I. Beggs says the line will be completed to Watertown as soon as possible. This was one of the pieces of extension work which was not stopped when the order for retrenchment was issued several months ago.

MILWAUKEE, WIS.—The Chicago & Milwaukee Electric road, which is now in receivers' hands, will be completed to Milwaukee and will be put in operation between this city and Evanston, Ill., about May 1, 1908, or practically on schedule time. Sufficient funds to complete and equip the road will be forthcoming as soon as the receivers can make a report to the court in Chicago as to what sum will probably be needed.

KANSAS CITY, MO.—All the surveys have been made for the Kansas City & Springfield Southern Railway, to build an electric railway between Nevada and Springfield, with a branch line to Carthage, with a capital of $3,750,000. The total length of the line, including sidings, will be 140 miles, and cars will be operated by electricity. The necessary current will be furnished from a power station which is to be built near Arcola, Mo.

MEMPHIS, TENN.—It is announced that the Westinghouse Electric and Manufacturing Company is preparing for submission to the promoters complete plans and estimates for the construction and equipment of the electric railroad from Fort Smith, Ark., to Shawnee, Okla. This line is to cost $1,250,000 as based on surveys and elevations submitted. The company was incorporated January 14 with a capital stock of $500,000. The main office is to be at Checota, Okla.

ALLENTOWN, PA.—At a meeting of the board of directors of the Allen Street Railway Company, at Bethlehem, Charles T. Hess, secretary of the Wilbur Trust Company, was elected president, *vice* H. Mutchler, resigned. John H. McGrath and Howard Mutchler resigned as directors, and W. A. Wilbur and W. B. Meyers were elected to fill the vacancies. W. A. Wilbur, W. B. Meyers and Charles T. Hess were elected members of the executive committee, with full power of the board of directors.

CHAMBERSBURG, PA.—At the annual meeting of the stockholders of the Chambersburg, Greencastle & Waynesboro Electric Railway Company George B. Beaver, of Waynesboro, was elected president. These directors were chosen: Chambersburg, Dr. R. W. Ramsey, T. M. Nelson, Joseph Sierer, Isaac Lesher, H. B. McNulty, Dr. David Maclay, A. N. Pomeroy, M. D. Lemasters, Andrew Buchanan, John C. Gerbig; Waynesboro, Dr. Walter Pearre, J. G. Corbett, D. Maurice Wertz, J. J. Oller, D. M. Good, J. W. Warehime, W. L. Minick, E. C. Stull and J. E. Royer.

GREELEY, COL.—As financial agent in charge of the Greeley Northern and Utility Company, F. O. Olson announced that all rights of way and a terminal had been secured by his road to within two blocks of the heart of the city. The road is now ready to proceed with its work within the city limits. There are four miles of road constructed, from Greeley to Evans, and work on the end nearer this city will be completed as quickly as possible. From Evans the road will go to Idaho Junction, there to connect with the Burlington, and from there will proceed to Denver over the Burlington.

INDIANAPOLIS, IND.—Articles of incorporation have been filed for the Cincinnati, Madison & Western Traction Company, to operate a line from Scottsburg, through Scott and Jefferson counties, to Madison, and thence in a northeasterly direction through Switzerland, Ripley, Ohio, and Dearborn counties in Indiana, and to Cincinnati, in Hamilton County; also, westwardly from Scottsburg to and through Salem, in Washington County, and through Paoli to West Baden and French Lick; also, southwardly from Scottsburg to Jeffersonville, New Albany and Louisville, Ky.; also, northwardly from Scottsburg to Bedford. The capital is $10,000 and the directors: J. E. Greeley, S. D. Miller, Maurice Cahill, G. B. Gaston and G. N. Owen.

WILKES-BARRE, PA.—Officers and directors of the various lines controlled by the Wilkes-Barre & Wyoming Valley Traction Company were elected at meetings held in the offices of the company. The companies for which directors and officers were elected follow: Wilkes-Barre & Suburban Street Railway Company, Coalville Passenger Railway Company, Wilkes-Barre & West Side Railway Company, Wilkes-Barre & Kingston Passenger Railway Company, Nanticoke Street Railway Company, Pittston Street Car Company, Plymouth Street Railway Company, Pittston, Moosic & Pleasant Valley Street Railway Company, Wilkes-Barre & East Side Railway Company, West Pittston & Wyoming Street Railway Company. The directors in all of the foregoing companies elected are: John A. Rigg, Remi Remont, Richmond L. Jones, Charles W. Laycock and T. A. Wright. The officers are: John A. Rigg, president; Remi Remont, first vice-president; C. W. Laycock, second vice-president; W. A. Rosen, auditor; T. W. Grookett, Jr., secretary and treasurer. The Wilkes-Barre & Plains Street Railway Company and the Pittston & Avoca Street Railway Company elected the following officers: John A. Rigg, president; directors, John A. Rigg, D. B. C. Catherwood, William R. McIlvaine, John M. Frame and T. A. Wright.

FREDERICK, MD.—At a largely attended meeting of citizens of Frederick and Montgomery counties at Buckeystown, a route for the proposed extension of the Washington, Frederick & Gettysburg Railroad, from Frederick to Great Falls, was decided upon, and a committee of fifty Frederick countians was appointed to solicit for the sale of stock in this county. This committee will co-operate with 100 solicitors now canvassing Montgomery County, and when $100,000 is raised the work of building the road will begin. The meeting developed the fact that the new road is practically a certainty. It is expected that between $50,000 and $75,000 worth of stock will be taken in Montgomery County, of which a large amount has already been subscribed, and the balance will be sold in Frederick County. The estimated cost of the road is between $700,000 and $800,000, covering a distance of about thirty-one miles. It will connect with the Old Dominion Line at Great Falls and run from there into Washington. The route decided upon is from Frederick to Buckeystown, thence in a southerly direction to the west of the Sugar Loaf Mountains, passing under the Baltimore & Ohio Railroad at Dickerson station. From the latter place the route runs in a southwesterly direction to Poolesville, thence southeasterly, near Seneca, to the Potomac River and down the Maryland side of the river to Great Falls. At this point the river will be bridged to connect with the Old Dominion Line on the Virginia side. Dr. Llewellyn Jordan, of Washington, presided. Among the promoters were Theodore J. King, chief engineer, and several managers of the Old Dominion Line and D. Columbus Kemp, Frederick, president of the road. It is understood that strong financial support in Washington will insure the success of the road after the first $100,000 is raised.

DATES AHEAD.

American Institute of Electrical Engineers. Annual dinner, Waldorf-Astoria, New York city, February 19.

Ohio Independent Telephone Association. Annual meeting, Columbus, Ohio, March 19.

National Electric Light Association. Annual meeting, Chicago, Ill., May 19-22.

INDUSTRIAL ITEMS.

THE FOSTORIA GLASS SPECIALTY COMPANY, Fostoria, Ohio, is distributing some very attractive literature devoted to its "Noblac" inner globes.

THE ROBERT INSTRUMENT COMPANY, Detroit, Mich., has published a new catalogue devoted to electrical measuring instruments. Copies of this catalogue may be had upon request.

THE ILLINOIS ELECTRIC COMPANY, Chicago, Ill., has ready for distribution its new net price list and discount sheets covering high-grade electric light supplies, construction material and specialties.

THE TRAY PLATE BATTERY COMPANY, Binghamton, N. Y., has published a leaflet devoted to the "Tray Plate" battery for ignition purposes. Copies of this bulletin will be sent to those interested upon request.

THE DE LAVAL STEAM TURBINE COMPANY, Trenton, N. J., has ready for distribution its Bulletin No. 501, devoted to turbine engines for driving dynamos or blowers, and turbine or motor-driven centrifugal pumps.

THE CHICAGO FUSE WIRE AND MANUFACTURING COMPANY, Chicago, Ill., has published an attractive booklet devoted to "Union" non-arcing enclosed fuses, fuse blocks, sectional switch boxes, outlet boxes, outlet box covers, fuse links, fuse wire, fuse strips, and wiremen's and engineers' fuse repair kit.

THE H. T. PAISTE COMPANY, Philadelphia, Pa., in its current bulletin, describes a new line of cross-over insulators. These cross-over insulators are equally valuable for making cross-overs or taking off a branch from a single circuit. There is also a description of Russell molding receptacles and new type Fielding receptacles.

DOSSERT & COMPANY, New York city, has sold a large order of solderless cable taps to W. S. Barstow & Company for use in the installation of the cement plant of the Fordwick Company, at Longue Pointe, Montreal. The Shawinigan Water and Power Company will supply current at 44,000 volts, which will be stepped down to 440.

THE WESTINGHOUSE ELECTRIC AND MANUFACTURING COMPANY, Pittsburg, Pa., has issued revised circular No. 1,104, devoted to portable and precision meters. This catalogue shows a large number of illustrations giving the applications of these meters to the measurement of single-phase and polyphase circuits. A carefully prepared index permits of ready reference to any desired subject.

THE SPRAGUE ELECTRIC COMPANY, New York city, has ready for distribution a series of handsome bulletins, devoted as follows: No. 107, continuous-current, direct-driven type S generators for lighting and power; No. 224, type D direct-current motors; No. 310, direct-current electric motors for operating ventilating fans and blowers; No. 507, flexible steel-armored hose for steam or compressed air.

THE H. W. JOHNS-MANVILLE COMPANY, New York city, held a convention of its branch office managers in New York city from January 29 to February 1. Managers of the various branches throughout the United States were present, and a general discussion of the business affairs of the company took place. The convention ended with a banquet at the Union League Club on Friday evening, January 31.

THE AMERICAN SPIRAL PIPE WORKS, Chicago, Ill., has issued an attractive bulletin devoted to spiral riveted pipes, forged-steel pipe flanges and hydraulic and exhaust steam supplies. A number of illustrations are shown, which indicate the applications of this form of pipe under very severe conditions. The bulletin will be found of great interest to those concerned with steam and hydraulic engineering problems.

THE F. BISSELL COMPANY, Toledo, Ohio, announces that it has an unusually large stock of cedar poles on hand for 1908. The company, being a producer of both Idaho and Michigan cedar poles, is in a position to take care of the largest orders. Besides a large supply of both large and small sizes which the company is now cutting, the stock sheets show a supply already at the yards sufficient to take care of any immediate demand.

THE ROYAL-EASTERN ELECTRICAL SUPPLY COMPANY, New York city, announces that it has arranged for the consolidation of the Eastern Electrical Supply Company and the Royal Electrical Supply Company. The new company will occupy the store and basement of 114 and 116 West Twenty-seventh street, and will carry a complete stock of approved electrical supplies, consisting of house goods, lighting material, motors and generators.

THE HOLMES FIBRE GRAPHITE MANUFACTURING COMPANY, Germantown, Philadelphia, Pa., manufacturer of the Holmes fibre graphite commutator brushes, dynamo brushes and kindred products, announces its recovery from the fire sustained in October of last year. Ample facilities are available to take care of all customers with the company's former promptitude and carefulness. The stock is in first-class condition to supply all demands with dispatch.

THE UNITED ENGINEERING AND CONTRACTING COMPANY, New York city, has published a brief description of the main features of the engineering work of the Manhattan cross-town tunnels of the Pennsylvania Railroad. This information was prepared for the use of the American Society of Civil Engineers on the occasion of the visit of its members to the tunnels, at the annual meeting in New York last month, and for the meeting of the American Institute of Mining Engineers during the present month.

THE GAIL-WEBB MANUFACTURING COMPANY, Buffalo, N. Y., is distributing some new literature describing its "Du-Plex" reflectors. This device combines the three features of reflector, protector and shade. It is made in the form of two corrugated cones, one inverted upon the other, and so constructed that it rests upon the bulb one-quarter way down and directly covering the lamp filament. This allows the light to be thrown upward and downward. The company also has some new literature devoted to its new form of wire lamp guard.

THE BOSTON GEAR WORKS, Norfolk Downs, Mass., has ready for distribution its catalogue devoted to standard gears. The company announces that the new addition to its factory, giving it fifty per cent additional floor space, or a total of 34,000 square feet, is very nearly completed. The company is constantly installing new machinery, and is in a position to execute orders for all kinds of gearing: Spurs up to ten feet in diameter and twenty-four-inch face, including medium-sized gears, bevels, spurs and racks, with generated planed teeth; worm gears up to eight feet diameter for worms up to eleven inches diameter; spiral gears in any ratio; automatic turning work up to sixteen inches in diameter, and small brass and model work of every description. The 1908 catalogue contains descriptions of 3,000 sizes of gears and ten pages of useful tables for mechanical work.

Record of Electrical Patents.

Week of February 4.

877,901. LOCKOUT DEVICE FOR PARTY-LINE TELEPHONES. William M. Bruce, Jr., Springfield, Ohio, assignor, by mesne assignments, to the American Automatic Telephone Company, Rochester, N. Y. A relay, operated by current, from central, locks out all but one instrument.

877,902. TELEPHONE SWITCH. William M. Bruce, Jr., Springfield, Ohio, assignor, by mesne assignments, to the American Automatic Telephone Company, Rochester, N. Y. A hook-switch.

877,914. TELEGRAPHIC TRANSMITTER. Patrick B. Delany, South Orange, N. J. Two groups of two electromagnets each maintain automatic vibration of the signaling armature.

877,915. TELEGRAPHIC TRANSMITTER. Patrick B. Delany, South Orange, N. J. A counterbalanced oscillating lever controlled by the key.

877,919. ELECTRICAL CONTACT DEVICE. Friedrich Fink, Recklinghausen, Germany. Contact strings are attached to the bottom of a slotted block of insulating material.

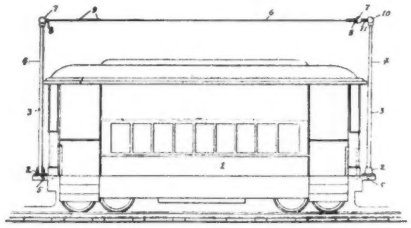
877,953. TROLLEY. Jean E. Saucier, Montreal, Quebec, Canada. Two arms attached to the harp carry a roller in the rear of the trolley wheel.

877,968. COMBINED TELEPHONE DROP AND JACK. Henry C. Thomson, Boston, Mass., assignor to Electric Goods Manufacturing Company, Boston, Mass. A signal-drop mounted on a grooved and perforated insulating block.

878,012. AUTOMATIC ELECTRIC SUPERVISORY AND SIGNALING SYSTEM. James G. Nolen, Chicago, Ill., assignor of one-half to Frank B. Cook, Chicago, Ill. A combined messenger-call and fire-alarm system.

878,013. ELECTRIC SIGNALING SYSTEM. James G. Nolen, Chicago, Ill., assignor, by direct and mesne assignments, of one-half to Frank B. Cook, Chicago, Ill., and one-half to Automatic Fire Protection Company. A system for operating a number of signaling devices.

878,017. PARTY-LINE TELEPHONE SYSTEM. Arthur F. Poole, Wheeling, W. Va. Each station is controlled by a relay and can be used when the latter is energized.



878,062.—Trolley Brush.

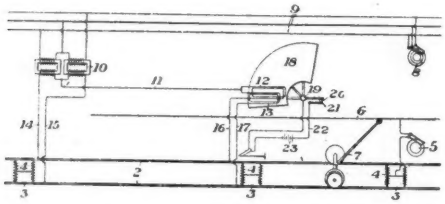
878,018. LOCK-NUT TELEPHONE SYSTEM. Arthur F. Poole, Wheeling, W. Va. The instrument at each station is controlled by a relay having two windings.

878,062. TROLLEY BRUSH. George Heineman, San Francisco, Cal. A brush constructed of a system of longitudinal and transverse wires.

878,087. ELECTRIC ALARM OPERATED BY ALARM-CLOCKS. Edward Ploudre, St. Louis, Mo. The clock rings a bell and lights a lamp.

878,106. ELECTRICAL SIGNALING APPARATUS. Benjamin F. Wooding, Denver, Col. An arm carried on the car closes the circuit between the two contact wires supported beside the track.

878,112. ELECTROMECHANICAL SWITCHBOARD SIGNAL. Ernest W. Brackett, Elyria, Ohio, assignor to the Dean Electric Company, Elyria, Ohio. The core of the magnet is provided with an arc-shaped tongue which extends around the drop.



878,138.—Alternating-Current Signaling Apparatus for Electric Railways.

878,138. ALTERNATING-CURRENT SIGNALING APPARATUS FOR ELECTRIC RAILWAYS. John S. Holliday, Wilkinsburg, Pa., assignor to the Union Switch and Signal Company, Swissvale, Pa. A two-phase signaling system for single-phase railways.

878,139. ALTERNATING-CURRENT SIGNALING APPARATUS FOR ELECTRIC RAILWAYS. John S. Holliday, Wilkinsburg, Pa., assignor to the Union Switch and Signal Company, Swissvale, Pa. An alternating-current signaling system employing a relay having two windings and intended for use on electric railways.

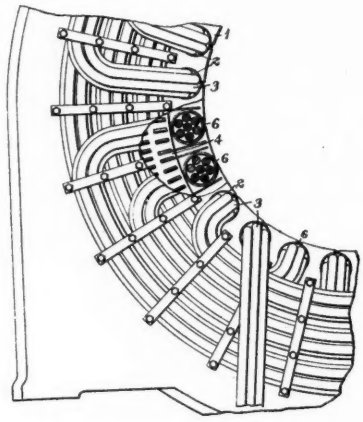
578,151. TELEPHONE SYSTEM. Albert L. Parcelle, Boston, Mass.; Walter A. Parcelle, administrator of Albert L. Parcelle, deceased. The local transmitter circuit has two branches but one of which contains the microphone.

878,165. DYNAMOELECTRIC MACHINE. Egbert M. Tingley, Pittsburg, Pa., assignor to Westinghouse Electric and Manufacturing Company. The magnetizable core is built up of groups of laminæ having a plurality of slots and spacing rings, the latter encircling the slots.

878,192. TELEPHONE TRANSMITTER. William W. Dean, Elyria, Ohio, assignor to the Dean Electric Company, Elyria, Ohio. The movable electrode engages intraperipherally with the flange of the diaphragm.

878,212. ELECTRIC FUSE. Swan J. Leveen, Rock Island, Ill., assignor of one-half to the Electric Construction and Machinery Company, Rock Island, Ill. An enclosed fuse.

878,247. OVERHEAD ELECTRIC CONTACT. Thomas W. Small, Cleveland, Ohio, assignor, by mesne assignments, to the Acme Automatic Street Indicating Company, Cleveland, Ohio. A contact for completing a circuit through a boss on the side of the trolley wheel.



878,165.—Dynamoelectric Machine.

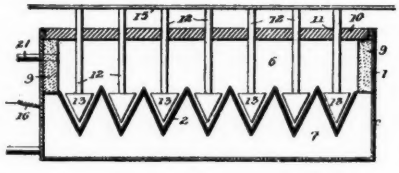
878,249. ELECTRIC APPARATUS FOR RAILWAY SIGNALING. Henry W. Spang, New York, N. Y., assignor, by mesne assignments, to Charles H. Ketcham, Yonkers, N. Y. A block-signaling system.

878,260. ELECTRIC AIR-COMPRESSOR. Nelson M. Watson, Detroit, Mich. A reciprocating compressor driven by two solenoids.

878,264. TELEPHONE CENTRAL-OFFICE APPARATUS. Charles S. Winston, Chicago, Ill., assignor to Kellogg Switchboard and Supply Company, Chicago, Ill. The outgoing trunk is provided with a bridged clearing out signal.

878,265. AUTOMATIC TRUNKING SYSTEM. Charles S. Winston, Chicago, Ill., assignor to Kellogg Switchboard and Supply Company, Chicago, Ill. A trunk circuit for connecting the lines of automatic and manual subscribers.

878,272. CONDUCTOR FOR DISCHARGING HIGH-VOLTAGE ELECTRIC CHARGES. William H. Chapman, Portland, Me. Resistances are inserted between the discharging points and the conductor.



878,425.—Electrolytic Apparatus for Electrolysis of Metallic Salts.

878,273. METHOD OF NEUTRALIZING STATIC ELECTRICITY. William H. Chapman, Portland, Me. The material is subjected to the action of a charge of high-potential of opposite polarity.

878,302. INSULATOR. Harley R. Markel, Dayton, Ohio. A divided cleat.

878,402. MAGNET FOR ALTERNATING CURRENTS. Christian Krämer, Frankfort-on-the-Main, Germany, assignor to Felten & Guilleaume Lahmeyerwerke, Actien-Gesellschaft, Frankfort-on-the-Main, Germany. A three-legged magnet, one winding of which is in series with a non-phase-displacing, current-reducing means.

878,425. ELECTROLYTIC APPARATUS FOR ELECTROLYSIS OF METALLIC SALTS. William H. Rines, Rumford Falls, Me. The cathode plate has deep V-shaped corrugations.

878,435. INDUCTION COIL. Richard Varley, Englewood, N. J., assignor to the Autocoil Company. A box for mounting an induction coil.